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June 26, 1924

Engineering News-Record

Steel Sheetpiling Used in Salt Water Harbor Work, Havana, Cuba

No other roof can be *Worth* as much

IF BUILDERS would pause to make a careful cost comparison they would find, as hundreds have found, that the architectural beauty of Federal Roof Tile is a luxury that costs nothing —that on the contrary it is the mark of inherent permanence without maintenance expense, uniformity of manufacture and correct design—qualities that make Federal Cement Tile the most economical of all roofs.

The comparisons made here are not visionary; they are supported by volumes of data in the files of the Federal Engineering Department—data that will convince you that no other roof, at any initial cost high or low, can be *worth* as much as Federal Cement Tile.

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These include tin and corrugated metal roofs of all kinds. With the exception of prohibitive, non-corrosive roofs, all must be continually scraped and painted and in spite of this they almost invariably rust out in the joints and from underneath. Moreover, temperature changes open joints, cause rust, and excessive repairs.

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These are either poured on the job or precast of fireproof material. It is an established fact that no material can rival the permanence of concrete, and concrete to be absolutely uniform must be precast under ideal conditions. There is nothing to burn about a Federal roof of precast concrete. It never requires covering when installed on pitched surfaces. Its life is measured in centuries. There are no repairs. It reduces insurance rates. Manufactured in the largest plant in the world, devoted exclusively to fireproof roofing, it stands on its record as the unrivalled roof.

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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For the Young Engineer

THE generous award made by John R. Freeman to the three engineering societies of which he has been president is especially directed to the younger engineers. Mr. Freeman's purpose is set forth in the letter to the societies reprinted in our news pages this week. He has in mind the starting of a fund, to which others may contribute and, during their lifetime, help to direct, the main purpose of which should be to encourage and assist toward greater professional knowledge those juniors in the profession whose preliminary education has been completed but who are so tied down by the necessities of earning a living as to prevent further studies or excursions which might yield large later dividends both personal and to the profession. These men Mr. Freeman would help. His is a good lead which others in the profession might well follow.

Visual Proof

COMMENDABLE enterprise has been displayed by the Niagara Falls Power Co. in the construction of the large-size model of Niagara Falls described on another page of this issue. Sooner or later more water will have to be diverted from the Falls. The demands of power make that certain. But the time has not yet come when the great cataract will be available as a scenic marvel only on Sundays and holidays, as a certain eminent scientist once prophesied. For years engineers have contended that proper, and feasible, remedial structures could be added above the Falls which would not only preserve the beauty of the spectacle with considerable less water than is now flowing but would tend to prevent that undue concentration in the Horseshoe of the Canadian Falls which is wearing back the rock there at the disturbing rate of 6 ft. per year. The model Niagara demonstrates this contention but it further permits experimentation on a large scale—which is most necessary. When the time comes—as it must come soon—for the two governments to take action toward greater draft and, consequently toward conservation of scenic grandeur, this model will well pay its rather high cost.

Road Materials Laboratories

TESTING laboratories in most of our state highway departments have been treated badly. Generally they have been denied quarters, equipment and personnel adequate to their needs. This is the situation reported by testing engineers of the Bureau of Public Roads who for two seasons have been visiting the testing laboratories used by the highway departments of the various states. Notable instances of good practice were found but these serve only to sharpen the contrast which the average laboratory practice presents. Enumerating their discoveries the Bureau experts conclude that "more thought for the welfare of laboratory operators, more careful arrangement of apparatus and a wiser selection of equipment would undoubtedly increase the efficiency of the average road materials laboratory many times over." As 55 laboratories in 45 states were visited the survey was certainly adequate for broad conclusions. Nor can the judgment of the examiners be impugned by anyone who has gone into many state road materials laboratories, and more often than not has had to dive into a dark basement or mount to a sweltering attic to make his visit. It is not all the fault of the road department engineers that the department testing laboratories are no better. Generally they have been denied the means for making them better. Indeed, coming from them demands for improvement are regarded as the routine bureau call for more money which it is a virtue to disregard. Here then is an opportunity for state engineering societies and associations of state highway contractors to do good work specifically within their power and range of influence.

Good News for the Rodman

WHEN Patrick E. Crowley, one time messenger boy on the Erie Railroad, succeeded Alfred H. Smith, who also started as a messenger boy, as president of the New York Central someone with a fondness for statistics looked up the records of the presidents and chairmen of the board of directors of the principal railroads of the country to see in what position these men started their railroad career. In the list produced the position of rodman predominates. Six of these men started as rodmen, and in addition one started as an axeman, one as an engineer of construction and one as an assistant in the engineer corps—which high-sounding title probably means rodman—making nine out of a total of twenty-eight. The names of these men are well known: Samuel Rea, S. M. Felton, W. B. Storey, E. J. Pearson, L. F. Loree, Julius Kruttschnitt, Howard Elliott, B. F. Bush and E. N. Brown. This study included only the men at the very top. If it had been carried down to include vice-presidents, general managers, and general superintendents the list of names of those who started their railroad careers in the engineering corps would be largely augmented. No one branch of the railroad field has a monopoly of the positions at the top. The rodman at the bottom need not feel that because there are few purely engineering positions at the top that the railroad field is a restricted one for him. The route that Felton and Rea and the others followed is still open. As "Pat" Crowley said, they got there by hard work.

Insurance or Prevention

COMMENTING on the half billion fire loss of America at the recent convention of the American Water Works Association, Franklin H. Wentworth,

secretary National Fire Protection Association, exposed the fallacy of the popular notion that the insurance companies pay the loss. The loss falls on the entire country. Primarily it is borne by the owners of insured property but they charge it to expense and raise prices accordingly. If it be argued that fire losses fall on stockholders of the insurance companies the answer is twofold: (1) Many of the companies are mutual; (2) decreased insurance company dividends through fire losses mean less money for current expenditures or capital investment and by that amount curtail either the demand for goods or else added means of production. Property burned is property destroyed. We rely too much on insurance against loss, too little on loss prevention. This is as true of life, sickness, burglary, street and other accident, as of fire. More effort should be directed to prevention; better building laws and supervision; more adequate fire protection through fire and water departments; increased health protection, through pure water and milk and scores of other means; less exposure of property of all kinds to thieves and burglars; better planned streets and more adequately controlled traffic. Some of the efforts just named partake largely of insurance, and where that is the case there should be a getting back to first principles—prevention. Some of the needed reforms depend on municipal or state action, but most of them should begin at home.

Keeping Automobiles Off the Streets

HOW serious traffic congestion is becoming in the central districts of some of our cities is illustrated by a proposal under discussion in Philadelphia. The proposal, as discussed by General Butler, head of the police department, and a representative of the Chestnut St. Association, incredible as it may seem, is to put up a 10,000-car garage, with twenty floors above and three below street level. Unless the proposers of this scheme have some undisclosed method of getting cars in and out of such a mammoth structure, the congestion of traffic in and around it at rush hours will be far greater than anything now existing.

Fantastic as this idea seems to be it is fairly indicative of the lengths to which planners are going in order to remedy the killing obstruction of our city streets by the growing parking evil. This is not confined to our large cities; indeed, it is greater in the towns and middle-sized cities where the distance between home and business more readily permits the automobile for the office-going man and for the shopping woman. But it is evident that unless stagnation of traffic with its high charges on business and industry is to prevail the alternative is some kind of costly construction, such as street widening or opening, or huge garages, or else a prohibition against the needless use of the space using automobile in the busy streets. Ultimately, perhaps, we must come to the costly expenditure and will have to decide where that expenditure is to be made, but for the time being there is great opportunity in most of our cities for some sort of experiment in the prohibition of traffic. New York has already tried, with some success, to eliminate the cruising taxicab from its busiest streets. Will not some courageous city head experiment with some prohibitory regulation against needless automobiling? The standing empty motor and the large limousine carrying one or two passengers are selfish infringers on the common right to use the streets.

Moving Forward on the St. Lawrence

LARGE engineering projects move slowly toward their fruition. History shows that about twenty years elapse between the first considered engineering report on such an enterprise as the Catskill aqueduct or the Moffatt tunnel and the actual starting of construction. The intervening years mark the lagging progress of political and financial discussion, rather than of engineering planning, but in public work these are major considerations and have to be satisfied before engineering can begin to function. There is, therefore, nothing abnormal in the progress of the St. Lawrence waterway scheme. It has been before the American and Canadian public now for the best part of a decade, and the renewed interest occasioned by the appointment of two new national commissions shows that the curve of progress is tracing a normal course.

The visit of the American commission last week to the lakes and river and the initiation of contact between the engineering advisors of both commissions serves, however, to direct public attention once more to this huge public works project, the greatest in possible expenditure now being seriously considered anywhere in the world. For the barest essentials of engineering construction the estimates of three years ago were two hundred and fifty millions; and four times that sum will probably be required to cover the full extension of the power and navigation facilities the development would open. It is, therefore, one of the greatest engineering enterprises of all time and as such is worthy the consideration of every citizen on both sides the line, though the fact is that outside of the relatively few who have made propaganda for or against it, the ignorance regarding the proposal is widespread.

What are the essentials of this project and what are the complications which prevent its early initiation? The proposal is that a ship channel be constructed from the Great Lakes to the Gulf of the St. Lawrence, a channel capable of carrying ocean vessels, which means at least 25 ft. and possibly 30 ft. deep, and which will be where possible in the bed of the St. Lawrence River and where that is not feasible in locks and canals paralleling the rapids which mark that river and the Niagara River which connects Lakes Ontario and Erie. Inasmuch, however, as the river falls nearly 600 ft. from the lowest lake to the tide and has a remarkably uniform flow of around 240,000 sec.ft., there is involved also the possibility of the generation of millions of hydro-electric horsepower.

This is the physical problem. The political one is involved in the fact that all of the Great Lakes and a large part of the river are an international boundary between the United States and Canada, and that the outlet of the river to the ocean flows entirely through Canadian territory. To build a ship channel through and around this mighty river and to generate power from its falling waters is a tremendous, though by no means impossible, engineering problem, but to adjust the charges for the cost of such a development not only between the two nations involved, but also between the waterway and the power use is an economic and political problem of far greater difficulty.

The dual problem has been officially studied many times but the culminating study was made by a joint international board which reported three years ago, and which came to definite conclusions. So complicated are the issues, however, that neither country was

prepared to enter negotiations based on the formal conclusions of the 1921 report, but appointed a new commission this year with instructions practically to duplicate the work of the earlier commission.

The problem before the present commissions—as stated to the American branch by the President—is first to decide whether the project should be undertaken now and, if so, to propose the fundamentals of international agreement on construction, finance and administration. These appear to be two separate problems but, in effect, the answer to the first depends on a satisfactory solution of the second. For the time being it may be assumed—to the horror, possibly, of the bourbons of New York City and Montreal and the Babbitts of Buffalo—that a deep channel to the lake ports will result in a considerable ocean-lake commerce which will benefit our inland territory and particularly the farmer, who is so sadly in need of benefit. It will take less of an effort to admit that power can be generated along the rapidly falling river so cheap and in such quantity as definitely to change the commercial balance of New York and New England.

But this is only the start of the problem. Who is going to pay for the work, the beneficiary of the commerce or the beneficiary of the power, the Canadian or the American; and in what proportion are to be divided the charges or determined the benefits? And this having been settled, who is going to pay for the harbor works necessary for the completely commercial utilization of the waterway and who is going to determine the ownership and control—whether public or private—of the power. These may appear to be generalities; indeed, the fault of the arguments for the St Lawrence development has been that they have been treated heretofore as generalities. The fact is that they are the crux of the situation and upon their settlement stands or falls the project. The commissions now starting work must consider them their most important duty and must prepare for their respective governments definite working plans of payment and operation distribution on which these governments can proceed to treaty arrangement.

It seems to be fairly obvious that it is the difficulty in settling these problems and of composing the sectional differences in both countries as well as the differences which exist between those, on both sides the line, who differ as to public or private control of power, which has led to what in less august circles would be called stalling on the St. Lawrence waterway. Both governments are reluctant to get down to the arduous work of treaty making, because a treaty now cannot deal in general terms but must particularize as to cost distribution and power control. Canada is burdened with debt; the watchword of Mr. Coolidge is economy. Ontario, through its publicly owned Hydro-Electric Power Commission wants St. Lawrence power and wants it immediately; New York is threatened with public ownership of power, and in any event claims the Niagara and other border waters. To cap the climax Chicago continues to stand on her professed rights to 10,000 sec.ft. out of the Great Lakes and remains, at least until the Supreme Court decision scheduled for next fall, both a thorn in the flesh of the United States and a red rag to wave before the Canadians. It is a most auspicious time to delay things with another official investigation.

But because this delay is now desirable the obligation upon the current commissions is doubly heavy. They must not only investigate and report on the physical and commercial possibilities of the project, but they must in very certain terms lay down the economic, diplomatic and financial solution so that the two governments will be presented with a complete program on which to proceed to frame the necessary treaty. Both commissions were appointed by existing governments. Each is headed by a strong man, who may be expected to influence his own administration. Provided the respective administrations remain in power, each in his own country, we may expect some immediate action as soon as the commissions report.

Engineering Supervision Needed

TWO FATAL railway accidents, reported upon recently, have again emphasized the necessity of frequent and careful inspection of all track, and particularly of main line track, by some one other than the regular track forces. Normally such inspection is left to the roadmaster, the division engineer making only such irregular inspection as his numerous other duties will permit. The danger of this practice is shown clearly by these two accidents and by similar ones which still occur at all too frequent intervals. In both cases the normal number of ties had been provided, the rail was of a good weight, and the ballast of fair quality. Superficial inspection—the motor car or observation platform kind—would have indicated that the track was O.K. But a closer inspection, made unfortunately after the accident had happened, revealed that although new ties had been put in, the rail had not been spiked to them, that too many of the other ties were decayed or deeply rail cut, that the gage was poor, many spikes loose or missing, and the superelevation irregular. Despite these facts, the roadmaster on one of the divisions concerned testified that he considered the track safe for schedule speeds.

The unfavorable financial condition of many of the railroads may be the cause but is no excuse for such conditions. The reason for such track lies in the general letdown of the morale of the maintenance forces as a result of the continual demand for economies through staff reduction and restricted expenditures. Nevertheless, it only takes a few men to keep track safe, at reduced speeds if necessary, and none of our railroads are too poor to provide the men for this purpose. If they are, they have no business to be operating trains.

What is needed on most railroads is that the maintenance forces be encouraged to make the best of what they have to work with through personal contact with the division officers responsible for their work, and stimulated to produce good track by the careful inspection of the same officers. Most roadmasters and track supervisors can do the greater part of this work effectively, although occasionally they do not, but whether they do or not, constant, independent inspection by some one with less of a personal interest in each subdivision is needed. This can best be done by the division engineers. Nothing will stimulate the interest of sectionmen in their section like having the division engineer walk over part or all of their section occasionally. Such inspection takes time; if the time is not available under the present conditions, then the conditions should be changed so that it will be. The safety of the public and employees is of first importance.

Steel Sheetpiling in Salt Water at Havana, Cuba

Submerged Sheeting for Wharf Is Cased in Concrete for 2 Ft. Below Water Level and Piles Are Painted—Rock Is Channeled to Receive Piles

IN ADOPTING steel piles for a recent permanent structure in the warm salt water of the harbor at Havana, Cuba, the decision was influenced largely by the very slight corrosion found in the steel of the U. S. battleship "Maine" after its wreck had been submerged for about thirteen years. The water in this harbor, which is of lower salinity than the open sea, has a temperature ranging from 72 to 86 deg. F., with an average of 81 deg.

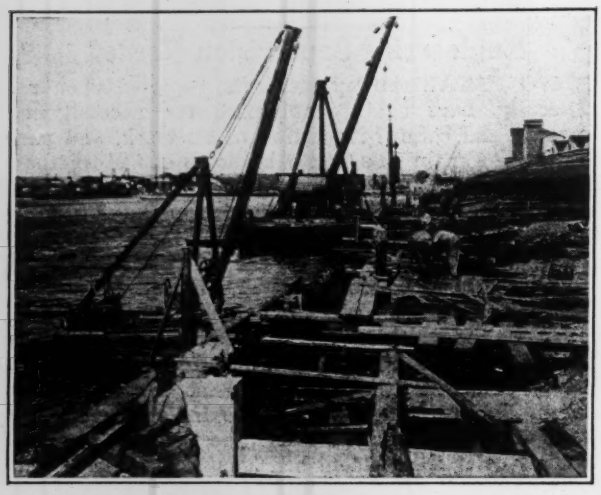


FIG. 1—BUILDING STEEL AND CONCRETE WHARF AT HAVANA, CUBA

The man in the left lower foreground is in front of one of the steel anchor piles and tierods cased in concrete. Beyond it the next anchor pile is bare, with shore end of its tierods concreted. The small floating derrick is placing forms for concrete wall enclosing top of steel sheeting. This sheeting is being driven by the large derrick boat, with steam hammer in suspended leads.

The new structure referred to, shown in Figs. 1 and 3, is a bulkhead for the wharf in front of the Regla warehouse of the United Railways of Havana. It consists of steel sheetpiling topped with a concrete wall which extends 2 ft. below the water line. All steel piling was given two coats of red oxide paint. The old wharf of timber piles and sheeting, with a small stone fill at front and back of the sheetpiling, had been badly damaged by the teredo, but recent ordinances of the sanitary department of the Cuban government prohibit any new construction in timber.

Design of Bulkhead—The general design and structural details of the new bulkhead are shown in Figs. 2 and 4. This structure, 500 ft. long, consists of a row of segments of vertical cylinders, 9 ft. 3 in. long on the chord, and with a middle ordinate of about 10 in., the curved faces being formed by interlocking steel sheetpiles. At each intersection of adjacent segments is placed a built-up steel anchor pile of I-section which interlocks with the sheeting. To these anchor piles are attached tierods which are anchored at their inshore ends to a continuous deadman consisting of a concrete wall in the solid ground behind the stone riprap fill of the bulkhead. These anchor piles are thus considered as vertical beams loaded along their entire length by the reactions from the pressures caused by the bulkhead filling and by a uniform live-load of 500 lb. per square foot on the fill. This bulkhead is designed for a dredged depth of 24 ft. of water, and the depth from water line to bottom of piling varies between 25 and 50 ft.

A 14-in. concrete wall 7 ft. deep and extending 2 ft. below the water line encloses the tops of the steel segments and the anchor piles. This wall, of 1:2:4 concrete, without any special ingredients to make it impermeable, is reinforced by longitudinal rods carried by short crossrods in holes in the piles, except that the bottom rods are suspended from a crossrod above

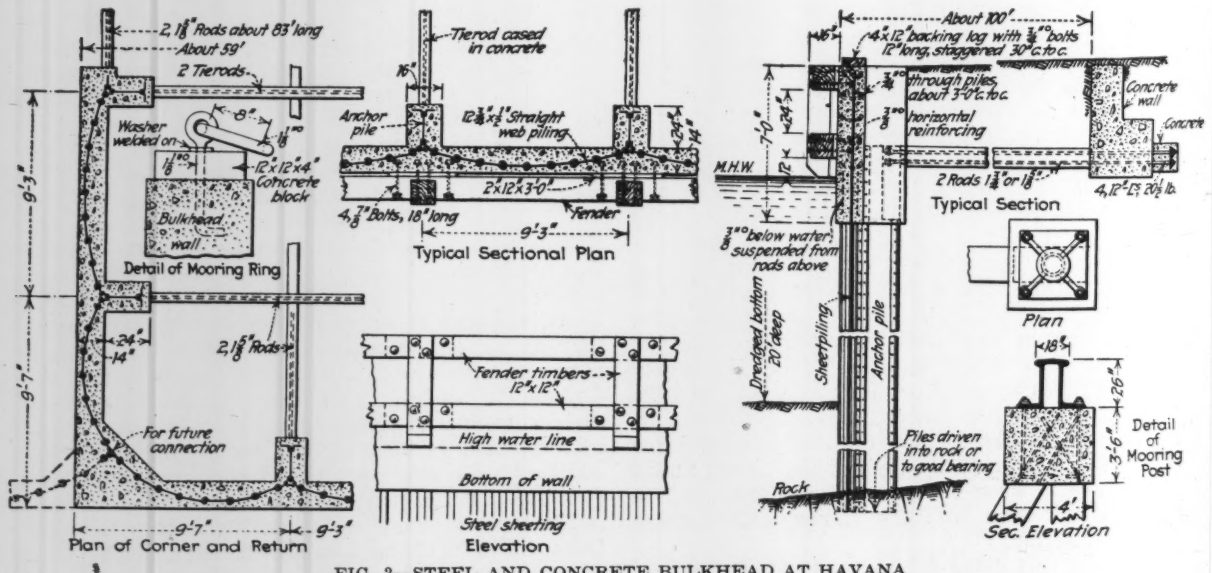
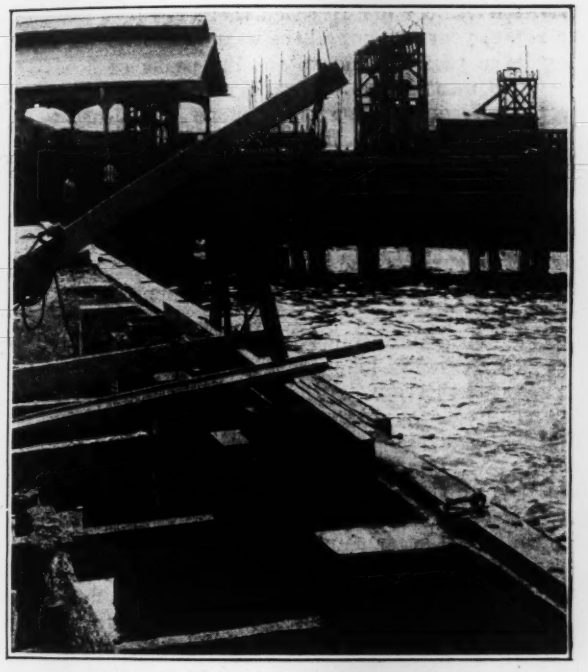


FIG. 2—STEEL AND CONCRETE BULKHEAD AT HAVANA

the water line. The tierods are also cased in concrete. On the top of the wall is a 4x12-in. string piece or backing log, and the face is protected by a fender of 12x12-in. timbers, as shown. Mooring rings are anchored into the wall, while behind the wall are mooring posts, each on a concrete block 48 in. square and 42 in. deep supported by two concrete piles.

Prior to preparing the design of this reconstruction an investigation of the site was made by means of test piles and borings, which indicated a layer of fairly hard rock at a depth of 25 to 55 ft. below the water, the latter depth existing at only a very short part of the length. On account of possible future dredging in front of the bulkhead, it was considered desirable to adopt a type of sheetpile which could be driven into the rock so as to obtain an anchorage on the lower end. It was found impracticable to obtain this penetration with concrete sheetpiles, and after a thorough investigation of different works executed in steel sheetpiling both in Cuba and along the Florida East Coast Ry. between Key West and the mainland, it was decided to use the type of bulkhead described above.

Construction Methods and Plant—The construction plant consisted of a 15-ton floating derrick, which was used for driving all the steel sheetpiles, and a traveling stiff-leg derrick on land for driving the returns on each end and also the piling underneath the mooring bits. There was also a concrete mixer and the usual run of miscellaneous tools. The driving of the sheetpiles was done by a steam hammer, which succeeded in putting the piles down to the required penetration without any difficulty, except for one end where considerable penetration was required in the rock on account of possible future dredging. This hammer was slung from the derrick scow and worked in the usual type of steel hanging leads.



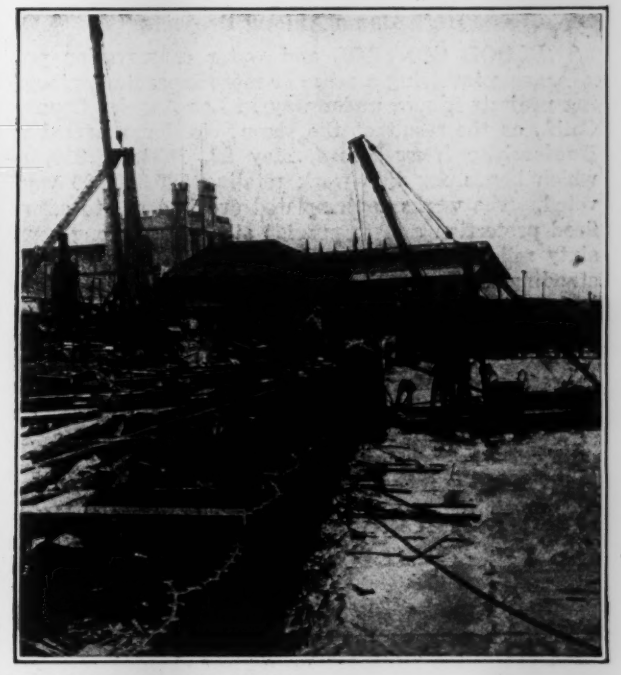


FIG. 3—BULKHEAD FOR UNITED RAILWAYS OF HAVANA

At right: segmental line of steel sheetpiling with steel plate anchor piles at intersections. At left: concrete wall encloses top of steel sheeting; anchor piles and tierods also cased. Improvised derrick for placing fender timbers. Wood string piece on top of wall, with concrete block under mooring ring.

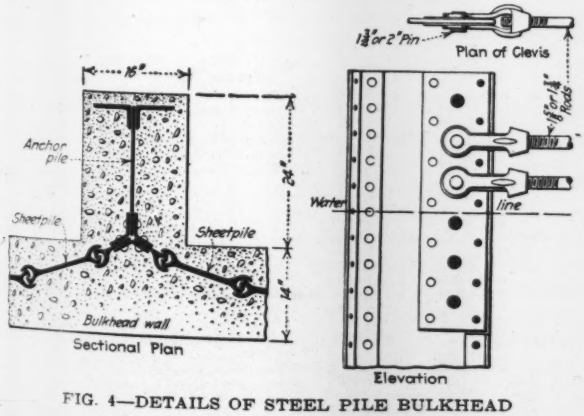


FIG. 4—DETAILS OF STEEL PILE BULKHEAD

On the one end mentioned above it was necessary to penetrate from one foot up to a maximum of 14 ft. into the rock. It was found that the sheetpiles could not be driven to more than about 24 in., beyond which depth drilling was necessary. This drilling was done by a 5-in. well-drill bit, weighted with 5-in. steel shaft 20 ft. long and operated from the derrick scow through an 8-in. pipe set in position on the bottom. By means of this a channel was broken through the rock, in which it was found possible to drive down the piles.

Where the old wharf interfered with the new construction, it was demolished. Templets were set up along the line of the sheetpiling, and four or five sections of piles were set. The anchor or built-up piles were first driven, and then the intermediate sections of sheetpiling. After fastening the anchor rods, the stone fill behind the bulkhead was placed up to the level of the bottom of the concrete wall in order to allow the wall to take as much as possible of the thrust

before the concrete was placed. This concrete was then poured in forms, the lower part being placed through a tremie. When the wall was complete the balance of the stone backfill was placed.

This bulkhead was designed and built by the Frederick Snare Corporation, contracting engineers, New York, under the direction of F. G. Sketch, chief engineer of the United Railways of Havana, Cuba.

Water Conservation Program for Los Angeles County

Bond Issue of $35,300,000 to Provide Flood Storage and Replenish Underground Sources—High Dams Among Projects

A FLOOD CONTROL and water conservation program involving a score or more separate engineering projects is now under way in Los Angeles County, Calif., as the result of the recent election reported in *Engineering News-Record*, May 22, 1924, p. 910, at which bonds for this work totaling $35,300,000 were voted. The works contemplated are laid out to afford flood protection and to provide storage all along some sixty miles of the San Gabriel foothills, but the outstanding feature and the most expensive item in the budget is the San Gabriel dam to be about 500 ft. high and to cost $25,000,000. Another phase of the work to which special interest will attach is the plan to replenish underground water storage basins that have been rapidly drawn down in recent years. An outline of the general flood control situation and a list of the works included in the recently approved budget is given in the following.

A precipitous range known as the San Gabriel Mountains, rising to heights of 8,000 and 9,000 ft., crosses Los Angeles County in an east and west direction and gives rise to floods that have periodically done great damage in the low plains to the south which the flood waters traverse on their way to the sea. The first flood protection measures were river channel rectification and the provision of flood channels supplemented by the construction of check dams in the mountains. After two serious floods in 1914 that caused damage amounting to $20,000,000 it was recognized that more effective protection was necessary and a flood control board was appointed. A review of the findings of this board and the flood control situation generally was published in two parts in *Engineering Record*, Aug. 14, 1915, p. 204 and Aug. 21, 1915, p. 232.

DAMS BUILT BY LOS ANGELES COUNTY FLOOD PROTECTION DISTRICT 1918-1924

Dam	Location	Reservoir Capacity Acre-Ft.	Overall Height Ft.	Drainage Area Sq.Mi.	Cost of Project	Date Completed
Devil's Gate..	Arroyo Seco at Pasadena.....	6,700	130	30	$406,000	1920
San Dimas....	Tributary to San Gabriel Ry.....	2,400	130	17	501,000	1922
Live Oak.....	North of La Verne	500	70	3	168,000	1922

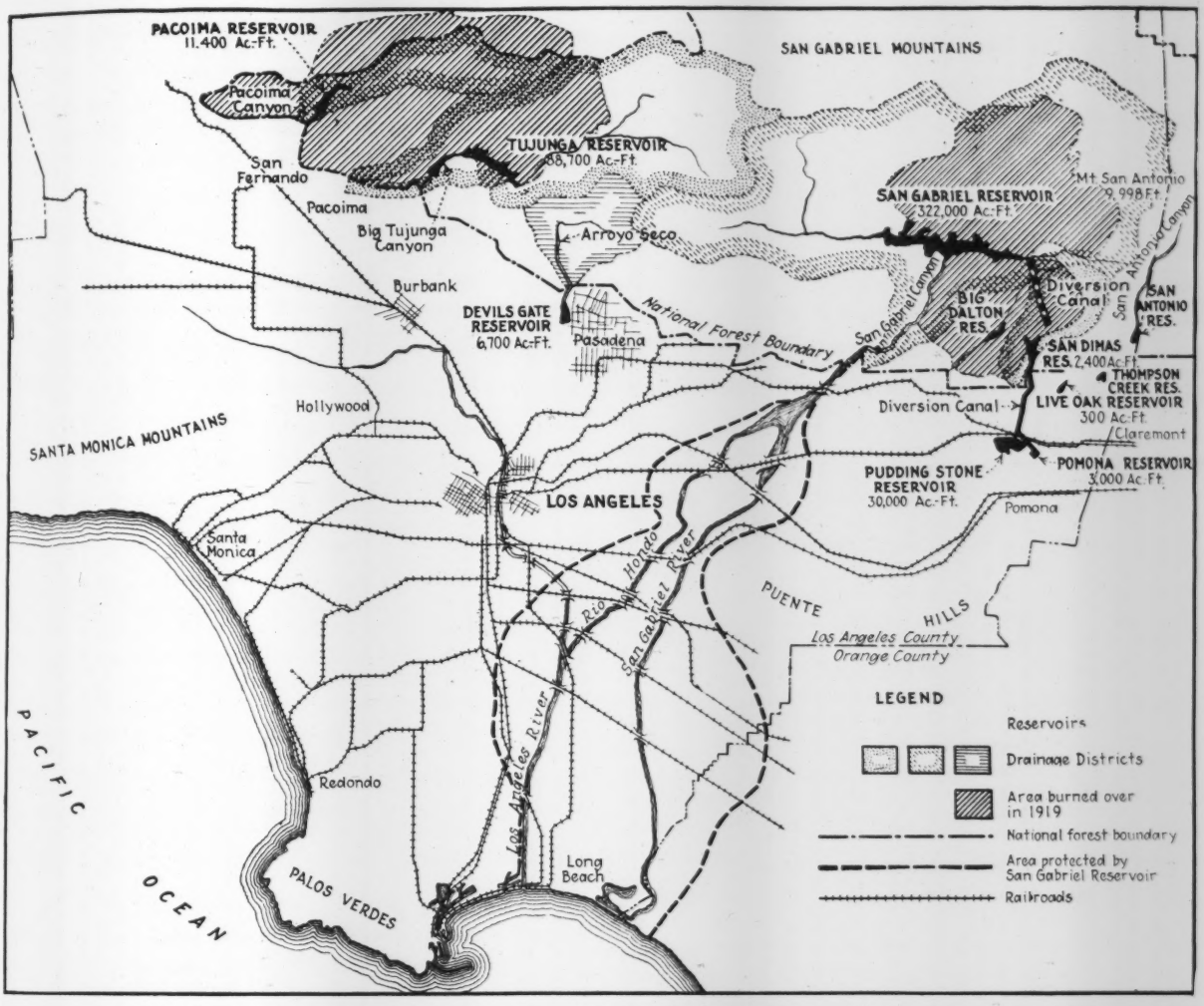
A minority report submitted by J. W. Reagan, one of the members of the board, was favorably received by county authorities and Mr. Reagan was made chief engineer for the Los Angeles County Flood Control District. Under his direction there has been developed in recent years a comprehensive program for constructing large reservoirs to retain the peaks of floods and to supplement these with other control and training works. Meantime work has gone ahead under Mr. Reagan's direction to the extent of the available funds. Since the first bond funds were available in 1918 a total of about $7,600,000 has been expended to date on county flood control work. This work has included the construction of several dams of considerable size as well as surveys and other studies for the larger and more extensive works involved in the program just approved.

The impounding dams for the reservoirs shown on the accompanying map are nearly all located near the mouths of the canyons through which the runoff from the basins above enters the valley. In the case of the Big Tujunga and the San Gabriel, suitable dam sites for the very large reservoirs were found only some distance up from the lower ends of the canyons. Even so, the drainage basins included in this program, as shown in the accompanying map, extend without break from the San Fernando Valley on the west to Claremont on the east and cut off the sources of all the floods that threaten the valleys below. A factor of the situation is that considerable portions of the mountainous area included in these drainage basins were burned over by forest fires in 1919 and the areas thus denuded are expected to increase the flood menace by hastening the runoff.

As the agricultural development of the valleys has increased and the towns are built up, the danger of floods has become a more serious matter because of the increased property value involved. There has been some conflict of opinion as to the management of the reservoirs because of the contrary requirements of flood

LOS ANGELES COUNTY FLOOD CONTROL PROJECTS APPROVED MAY 6, 1924

	Projects	Capacity Acre-Ft.	Cost	Type of Dam	Height, Ft.
1	Retarding dams, Pomona, San Antonio Canyon and spreading grounds	.....	$450,000	.....	.....
2	Thompson Creek reservoir	520	146,000	Two earth dams	72 and 30
3	Big Dalton reservoir	1,200	555,000	Multiple arch	155
4	San Gabriel reservoir (200 sq.mi. drainage)	200,000	25,000,000	Concrete, gravity arched in plan	500
5	Sawpit Canyon reservoir	350	241,000	Concrete, arched 200-ft. radius	140
6	Big Santa Anita reservoir	1,530	586,000	Concrete, constant angle arch	235
7	Sierra Madre canyon (small concrete and wire bound check dams)	.....	150,000	.....	.....
8	Eaton Canyon reservoir	1,033	603,000	Concrete, constant angle arch	220
9	Altadena storm drain	.....	250,000	.....	.....
10	Pickens canyon (one small arch and masonry or wire bound check dams)	.....	100,000	.....	.....
11	Verdugo wash, Sycamore canyon, Glendale and Los Angeles city (open concrete conduits)	.....	450,000	.....	.....
12	Wire bound dams in Dunsmuir and other canyons	.....	150,000	.....	.....
13	Haines canyon (wire bound rock check dams)	.....	100,000	.....	.....
14	Big Tujunga reservoir	14,000	1,600,000	.....	.....
15	Pacoima reservoir and resort damage (30 sq.mi. drainage)	11,600	1,720,000	Concrete, constant angle arch	375
16	Work on lower Ballona creek	.....	250,000	.....	.....
17	Work at Virginia City at Long Beach	.....	500,000	.....	.....
18	Work upon the lower east San Gabriel River near Artesia	.....	600,000	.....	.....
19	Puddingstone reservoir and channel to San Dimas Wash	20,000	1,750,000	1 concrete 3 earth	170 20, 53 and 63
20	Incidental expenses	.....	99,000	.....	.....
	Total		$35,300,000		



RESERVOIRS AND DISTRICT PROTECTED BY FLOOD CONTROL PROGRAM OF LOS ANGELES COUNTY
Railroad crossings of the waterways indicate a large number of bridges involved.

protection and irrigation uses. Flood control purposes, of course, are best served by an empty reservoir so long as there is any likelihood of a heavy runoff that might need to be checked by storing the peak. Irrigation and water supply systems, on the other hand, are served best by always keeping the reservoir full when possible. This clash of interest has already been manifest in the Devil's Gate dam which by retaining and diverting water through subterranean reservoirs has materially augmented the water supply of the Pasadena water basin. The effect of the dam on this basin was discussed in *Engineering News-Record*, May 11, 1922, p. 771.

The replenishing of underground storage is an important feature of the flood control plans as now laid out. As an indication of how subterranean storage has been depleted, the flood district reports state that in the early nineties artesian wells flowed above ground on an area of about 177 square miles in the San Gabriel valley. The artesian plane in this valley has lowered until now artesian water can be brought above ground in an area of only about 28 square miles, and in areas formerly watered without pumping the artesian plane has steadily gone on down below ground level. Outside the artesian areas the water table has also steadily gone down as more wells have been sunk. The cost of pumping has correspondingly increased and areas that should have an underground supply are now practically without water.

The delta cones of several streams on which dams are planned have similar conditions and the same general policy is to be used in operating the several reservoirs, i.e., to give the maximum benefit to underground storage basins consistent with protection against dangerous floods. In the San Gabriel reservoir, for example, it is the plan to permit a continuous discharge at a regular rate throughout the winter rain period, this rate to be such that the gravel beds will be absorbing to capacity until filled. It is estimated that 500,000 acre-ft. can be handled through the reservoir in this way without wastage. The gravel constituting underground basins would then be filled after which the gates can be closed and the reservoir allowed to fill to capacity.

The flood control dams thus far built are those at Devil's Gate, at San Dimas, and the small dam at Live Oak Canyon. These and other chief features of the work done to date are given in an accompanying table.

For some time the Pacoima dam has been scheduled for construction next, and as all preliminary studies and designs for this structure have been completed it will probably be the first extensive work to get started under the new bond issue. Pacoima dam is to be a constant angle arch 375 ft. high, 108 ft. thick at the base and 8 ft. thick on top, forming a reservoir with a capacity of 11,600 acre-ft. Favorable reports on the Pacoima dam have been made by the chief engineer of the U. S. Bureau of Reclamation, by the California state engineer and by the city engineer of Los Angeles.

The San Gabriel reservoir, when filled, will form a lake 1,745 ft. above sea level, 8 miles long, with an area of 1,300 acres and a storage capacity of 200,000 acre-ft. The dam itself, which will be of record size, will have a maximum section 410 ft. wide on the base which will be embedded about 25 ft. in rock, making the base of the dam about 55 ft. below the bed of the stream. Cutoff walls at the center of the section and at the up and downstream faces will extend some 15 to 25 ft. deeper, making the total height of the structure from bottom of cutoff walls to top of parapet about 500 ft. It will be about 2,100 ft. long on top and will contain 2,500,000 cu.yd. of concrete.

Final details of design on this dam have not yet been worked out, the dimensions given above being only the approximations that most nearly fit the conditions developed in preliminary studies. Several rows of diamond drill borings which are being made 50 ft. apart across the dam site have shown very favorable foundation conditions. The maximum depth of gravel is about 60 ft.; below this solid granite has been found. At some points the drills have been driven as much as 70 ft. into the granite making a total of 130 ft. below river bed, without finding fissures or other indications of weakness or previous strata.

Most of the projects planned under this flood control and water conservation program can be constructed within a period of three to four years. The San Gabriel dam on which most of the preliminary work, such as surveys, foundation exploration, etc., has already been made, will require five or six years to build. Work is to be under way, according to Mr. Reagan, on as many of the projects as is practicable during the present season.

Rocker Pedestals to Resist Earthquake Shock

To protect buildings from earthquake damage, Mario Viscardini, of Milan, Italy, has developed the idea of making the superstructure of a building capable of yielding to the abrupt shock of earthquake movements, by the use of rocker pedestals in the lowest story of the columns. His proposal was recently set forth in *Ingegneria*, and has been put out in pamphlet form more recently (published by Stucchi Ceretti Co., Milan). In his typical design the lower story length of column has a large-radius spherical bearing similar to a turntable disk bearing near its lower and another near its upper end, the two bearing surfaces being parts of the same sphere. Flange bolts connect this rocker length to the portions of column above and below, and normally hold the building stable; the bolted connection is intended to be weak enough to rupture under the displacement due to an earthquake shock. At wall bearings, a two-way roller bearing is used in place of the spherical support.

Classifying Asphalt Sands by Graphical Method

Triangular Diagrams Give Simple and Rapid Means of Classifying Sands and Proportioning Sheet Asphalt Mixture

By W. C. D. Haarman

Consulting Highway Engineer; Assistant Professor at University of the Dutch East Indies, and Member of the Board of the D.E.I. Road Congress, Bandoeng, Java

GRAPHICAL methods are of great value when a number of tests are to be compared at a glance. One of the best is the triangular diagram. This diagram has been used to classify chemically the igneous rocks but so far as the writer knows it has not been used to classify sands for sheet asphalt.

Clifford Richardson gives the ideal mixtures of sands for sheet asphalt as follows:

		Light Traffic	Heavy Traffic
Passing	100 and 80 mesh (coarse)	20	34
	50 and 40 mesh (medium)	25	43
	30, 20 and 10 mesh (fine)	35	23

These mixtures are indicated in the diagram by *L* and *H* and the composition can be seen quickly from the diagram.

The limits of variation of the compositions of coarse, medium and fine grains can also be introduced in the diagram. For example, the limits as prescribed by the Asphalt Association being fine 16-40 per cent, medium 30-60 per cent and coarse 12-50 per cent form the area inside the dotted line. Every sand or mixture of sands suitable for sheet asphalt within the limits set by the Asphalt Association must come into this area. If not, it cannot be used. The best mixes lie on the line *LH*.

The diagram is extraordinarily convenient for recording a great number of sands in a small space. In Fig. 1, the five sands of Table I of page 947, "American Highway Engineers' Handbook," are recorded. Not one of these sands lies inside the dotted area and also no single sand can be used but by mixing two or three a good mixture can be secured.

TABLE I—ANALYSES OF BEACH SANDS FROM AMERICAN LAKES

A correction has been made for the dust and the sand retained on the 10-mesh sieve; each of the three sizes has been calculated in per cents of their sum.

		A Lake Michigan P.C.		*B* Lake Michigan P.C.		*C* Lake Erie P.C.		*D* Lake Ontario P.C.		*E* Lake Pontchartrain P.C.	
Passing	200 mesh	1		10		1		2		0	
	100	3	8	55	87	9	30	4	46	0	1
	80	5		23		20		41		1	
	50	31	52	6	11	39	60	39	47	25	75
	40	20		4		20		7		50	
	30	15		2		6		4		19	
	20	13	40	0	2	3	10	2	7	4	24
	10	12		0		1		1		1	
Retained on	10 mesh	0		0		1		0		0	

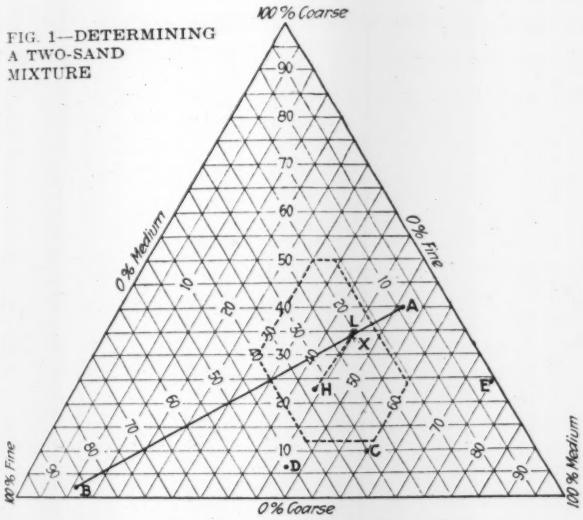
If a mix for light traffic is required it is necessary to mix sand *A* with sand *B*, which in the diagram is done by drawing the line *AB*. All the mixtures that can be made with these two sands are represented by the different points of the line *AB*. As *A* represents 100 per cent sand *A*, and *B* 100 per cent sand *B*, it is easy to see that a sand in the middle of *AB* will consist of equal parts sand *A* and sand *B*. The mixture *X* is one that lies close to the ideal mixture for light traffic.

TABLE II—REMIXTURE OF TWO SANDS IN TABLE I TO OBTAIN SAND SUITABLE FOR SHEET ASPHALT

	Parts for 5A	Parts for 1.1B	Total Parts	Per Cent	Per Cent of Total	Per Cent of Sand
Dust	5	11	16.0	2.6	2.6	....
Passing 100 mesh	15	60.5	75.5	12.4	20.7	21.2
80	25	25.3	50.3	8.3		
50	155	6.6	161.6	26.5	43.5	44.7
40	100	4.4	104.4	17.0		
30	75	2.2	77.2	12.7	33.2	34.1
20	65	0	65.0	10.7		
10	60	0	60.0	9.8		
Totals	500	110	610	100		

This mix is composed of XB/AB parts sand A and of XA/AB parts sand B. The dimensions can be obtained by measuring or by subtracting. The length of projection of AB on the fine sand scale is 87 — 8 = 79; AX measures 21 — 8 = 13; BX is 87 — 21 = 66. Thus to obtain mixture X take 66 parts of sand A and 13 of B or in practice 5 A and 1 B.

FIG. 1—DETERMINING A TWO-SAND MIXTURE



Sand B in nature contains 10 per cent dust; therefore about 110 per cent must be taken from the heap to get 100 per cent of the sand B from the diagram. The real mix in this case will be 5 A and 1.1 B.

Controlling this mix as shown by Table II gives a very satisfactory sand for light traffic.

To make a good mixture for heavy traffic it is necessary to blend three sands. If a heavy traffic mixture is to be made from sands A, B and C, two sands are mixed first, Fig. 2, and then to this mix the third is added. Sands A and B will make every sand of the line AB. If line CH is drawn until it crosses AB, it will be clear that this mix Y of A and B will make H by mixing Y with sand C. Mixture Y is composed of 35 — 8 = 27 parts B, and 52 parts A, or, simplified, 2 parts A and 1 part B. Mixture H can be obtained by mixing 13 parts Y and 4 parts C, or, simplified, 3 parts Y and 1 part C. The total mix H also consists of 2 parts A and 1 part B and of this mix taking 3 parts with 1 of C. Correcting B for 10 per cent dust the exact mixture will be as given by Table III.

From the diagram it can immediately be seen that a good mixture cannot be made from three of the four sands $ACDE$. However it will be possible to make one that falls inside the area and may give sufficient results. With A and B and one of the three sands C, D or E, a heavy-traffic mixture can be made without difficulty. To be sure whether it is possible to make a fair mixture, either for light or for heavy traffic, of a number of sands, put them in the diagram and see if the point L or H lies inside the area formed by connecting them, in Fig. 2; for example, triangle ABC. If it does, a fair mixture can be made; if not, it is not to be made.

FIG. 2—DETERMINING A THREE-SAND MIXTURE

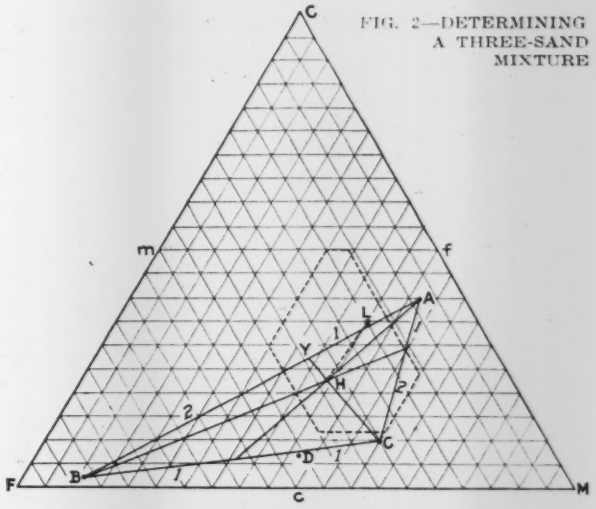


TABLE III—REMIXTURE OF THREE SANDS OF TABLE I TO OBTAIN SAND SUITABLE FOR SHEET ASPHALT

	Parts for 2A	Parts for 1.1B	Parts for 1C	Total Parts	Per Cent	Per Cent of Total	Per Cent of Sand
Passing 200 mesh	2	11	1	14	3.4	3.4	....
100	6	60.5	9	75.5	18.4	31.9	33.0
80	10	25.3	20	55.3	13.5		
50	62	6.6	39	107.6	26.2	41.9	43.6
40	40	4.4	20	64.4	15.7		
30	30	22	6	38.2	9.3	22.6	23.4
20	26	0	3	29.0	7.2		
10	24	0	1	25.0	6.1		
Retained on 10 mesh	0	0	1	1.0	0.2	0.2	
Totals	200	110	100	410	100		

Comprehensive Highway Program of Panama

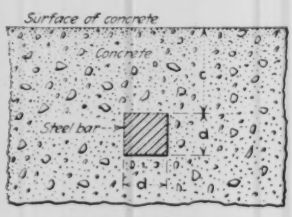
The National Congress of Panama in 1920 authorized a comprehensive highway construction program which has been greatly accelerated by the $4,500,000 government loan successfully placed in this market in 1923. Contract was given to the Compania Constructora de Panama for the Chorrera-Rio Tetita division of 55 kilometers, and to R. W. Hebard & Co. of New York for the Tetita-Anton division of 60 kilometers, which carries a large amount of heavy and difficult work including erection of 30 large steel bridges. The Araijan-Chorrera section is to be carried out jointly by the government of Panama and the Canal Zone authorities. With the completion in 1926 of the work now contracted, the Republic of Panama will have 350 kilometers of modern highway extending from the city of Panama west through the states of Panama, Cocle, Veraguas and Los Santos. The work is administered by a National Road Commission appointed by the president of the republic. R. K. West is chief engineer of the commission.

Should Reinforcement Embedment Vary with Size of Bar?

Examination Into Stresses Set Up By Temperature Changes in the Surface Areas of Reinforced Concrete

By A. S. Woodle, Jr.
Engineer of Plant, The Baldwin Locomotive Works, Philadelphia, Pa.

MUCH of the feeling of uncertainty which many engineers have today with regard to the general use of reinforced concrete, particularly on work exposed to the weather, is caused by the unsightly cracks and spalling which are only too frequently seen on structures from five to ten years old. It is generally recognized that disintegration of this kind is caused by corrosion of the steel reinforcing rods, the iron oxide formed by the corrosion occupying six or seven times as much space as the steel from which it is formed and thus cracking and pressing out the protecting shell of concrete. Specifications and inspection have of late years become very much more rigid than they formerly were in the matter of seeing that the steel bars are properly placed in the form and fastened in place so they cannot move during the operation of pouring. The matter of design covering the location of these rods in a concrete beam so they will not rust may be examined with possible profit.



ANALYSIS OF STRESSES IN CONCRETE EMBEDMENT

What causes the steel bars to corrode? It is well known that steel bars even if originally coated with rust, if kept covered with sound concrete will not only not corrode further, but will be cleaned of the original rust, the iron oxide disappearing, due probably to absorption of the oxygen by the lime in the cement, leaving the blue steel. The obvious inference is that corrosion cannot occur unless the concrete is cracked in some way, thus permitting access of the corroding influence of air and moisture to the steel.

The writer endeavors to show in the following analysis:

1. That owing to the slight difference between the coefficient of expansion of steel and that of 1:2:4 concrete there is a force acting under certain temperature conditions against the layer or "bridge" of concrete which protects the steel.
2. That this force is large enough in many cases to break the concrete "bridge" and cause cracks to appear.
3. That the force is a direct function of the dimensions and shape of the reinforcing bar.
4. That it is perfectly practicable to design the concrete protection or "bridge" strong enough to resist the expansive force due to any assumed temperature difference and thus protect the steel indefinitely as long as the assumed temperature difference is not exceeded.

It should be remarked at this point that this examination is intended to be qualitative in character rather than quantitative. It is not claimed that the mathematical analysis as far as it goes is exact. The whole purpose has been to bring out and state a reason for the fact that the cover of concrete over a steel rod is a direct function of the size of the rod, and that a cover which will adequately protect a sheet of expanded metal, for example, cannot be expected to protect a 6-in. I-beam.

In proceeding with the analysis the following assumptions are made:

1. Coefficient of expansion of steel.....0.000006
   Coefficient of expansion of concrete..0.0000055
   and therefore excess of steel over concrete
   = ... 0.0000005
2. Outside temperature difference....100 deg. F.
3. Temperature difference inside the concrete at a point near the surface.....50 deg. F.

We may also assume that the bar of steel is sufficiently close to the surface of the concrete and the body of the concrete sufficiently thick so that the entire effect of the swelling of the steel due to temperature would be toward the near surface.

Now consider a steel bar d inches square with an amount of embedment (i.e. the distance of the steel from the surface of the concrete) to be c inches, as shown in diagram.

Then for the given temperature difference (50 deg.) we may design the embedment c so that the deflection in the small concrete "bridge" over the steel bar will not be sufficient to cause more than a safe tensile stress in the concrete.

The concrete "bridge" can be considered as a beam with supported ends, of depth c and unit width, with a uniformly distributed load of W lb.

Then the deflection y due to the load W will be $5Wd^3/384\,EI$.

If for E modulus of elasticity we use 2,000,000 and for I moment of inertia we use $c^3/12$ we have the equation

$$y = \frac{5Wd^3}{64{,}000{,}000\,c^3}$$

We also have for the deformation on account of temperature difference

$$y = 0.0000005 \times 50 \times d$$

Equating the two values of y

$$\frac{5Wd^3}{64{,}000{,}000\,c^3} = 0.0000005 \times 50 \times d$$

or

$$W = \frac{320\,c^3}{d^2} = \text{amount of load}$$

The maximum fiber stress in concrete beam due to load $W = M/S$ where M = bending moment = $Wd/8$; and S = Section Modulus = $c^3/6$.

Therefore the fiber stress = $\frac{320\,c^3 \times d}{d^2 \times 8} \times \frac{6}{c^3} = \frac{240c}{d}$

and if we put down 240 as the fiber stress, we have $c = d$. In practical design a factor of safety of say 2 would be recommended; that is make $c = 2d$.

In the case of a round bar, conditions would be somewhat different as the loading of the "bridge," which in this case would be arch shaped, would be of a fluid character, that is, normal to the intrados of the "arch" on purely radial lines and the exact analysis would develop a different set of equations, but it can be readily seen that the worst case is that of the square rod, so that there appears to be no need of going into the case of the round rod in any detail.

In view of the analysis so far made, the following conclusions are not unreasonable:

The amount of security against cracking of a concrete surface due to corrosion of the reinforcing bars varies directly as the diameter or square size of the rod.

The amount of embedment required varies directly as the diameter or square size of the rod. These calculations corroborated by experience having shown that 2 in. of cover over a 1-in. rod or ¼-in. cover over a ¼-in. wire is needed to protect the steel, it is felt that this fact should be recognized and covered in greater detail than is now the case in standard specifications.

Wheel Guiding Flange Frogs for St. Louis Terminal

Eliminating Guard Rails in Heavy Traffic Yard Layouts Reduces Track Maintenance—Solid and Built-up Frogs

IN THE improvement of the complicated track layout of the Terminal Railroad Association of St. Louis, Mo., a conspicuous feature is the extensive use of flange frogs of the Graham type, with which each wheel passing through the frog is guided by its rim, or outer edge of the tread, engaging a rib or flange which projects above the level of the rail head. This arrangement is quite distinct from the ordinary construction, where each wheel passing through the frog is guided by means of the wheel on the opposite end of the axle, the back of the flange of this latter wheel engaging a guard rail adjacent to the track rail opposite the frog. Thus each flange frog eliminates the two guard rails and their attachments.

In the No. 7 solid manganese cast frog of this type, as made for the St. Louis installation and shown in Fig. 1, it will be seen that the flange is 1¼ in. high above the rail and 1¼ in. wide. At the throat, this flange flares away from the gage line of the frog, an arrangement which is said to give an easier entrance angle and less shock to the wheels in engaging the flange than would be the case if the frog flange was parallel with the gage line. Projections serving as tie-plates are formed on the base of the frog casting, and at both ends of the frog the connecting rails, of 100-lb. section, are supported by tie-plates.

Another frog of the same type, but built up of rails and manganese steel castings is shown in Fig. 2. These

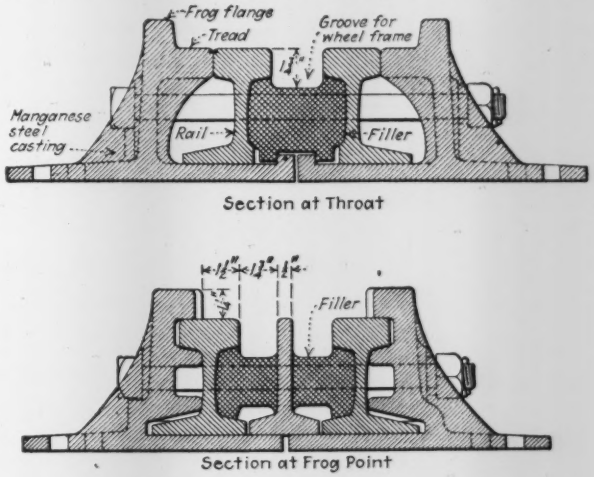


FIG. 2—DETAILS OF BUILT-UP FLANGE FROG

frogs, which are used less extensively than the cast frogs, are designed for use where the flange frogs have to be fitted to existing layouts and rail joints, being made interchangeable with the ordinary type of frog. In this case, it will be noted that the flange castings form a continuous base for the rails, which are thus held up to their work, the whole structure being well bolted together.

Flange frogs are being applied largely in yard work and in other locations where switching movements are numerous. They are not so well adapted to main-line

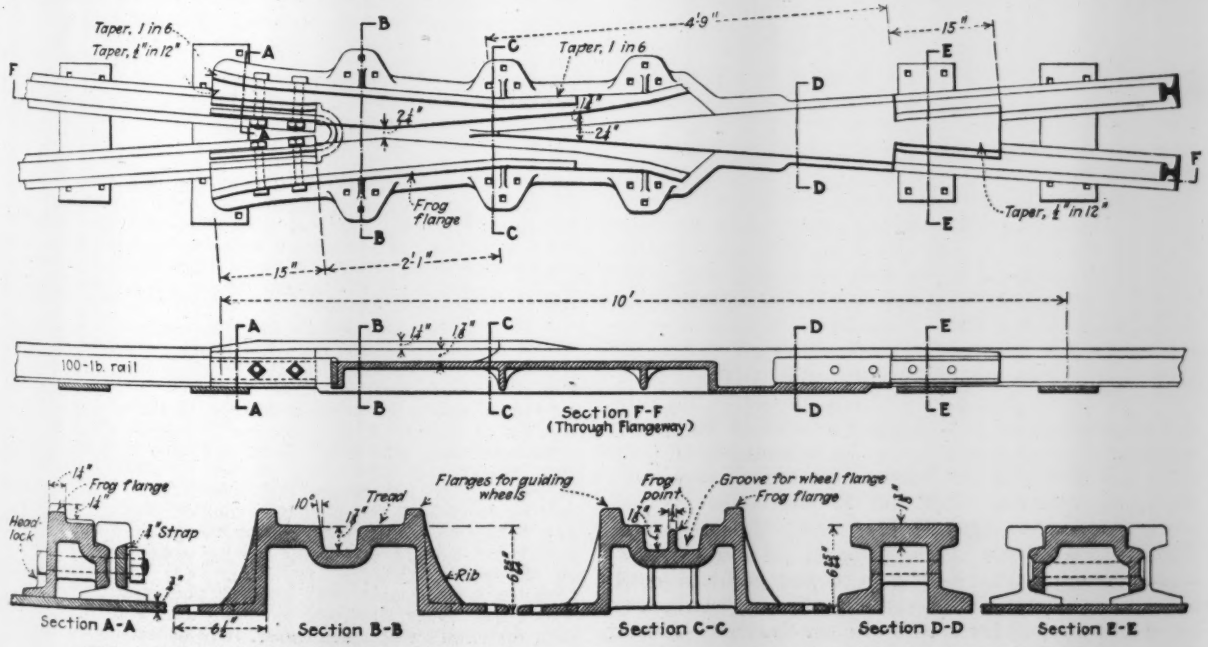


FIG. 1—CAST-MANGANESE FLANGE FROGS FOR TERMINAL RAILROAD ASSOCIATION OF ST. LOUIS

work, since main-track turnouts usually have spring-rail frogs to give smooth running. However, the makers consider the flange frog suitable for main-line crossovers used frequently for switching movements. This is indicated by the use of these frogs for practically all of the tracks of the St. Louis Union Station and terminal layout where passenger trains operate at considerable speed.

About three years ago a dozen of these flange frogs were installed by the Terminal Railroad Association in the track layout of the St. Louis union station, and they proved so satisfactory that this type was adopted for all frogs, except in high-speed main tracks. The flange frog is found to be much more satisfactory than the ordinary type of frog with guard rail; in fact, it is stated that when a frog of the flange type is installed it requires little if any more attention than an equivalent stretch of unbroken track. Furthermore, the engineer considers that the flange frog will materially reduce the liability of derailment and will also reduce the tie renewals now made necessary by damage due to continual respiking of guard rails, while it will eliminate the constant work and expense for adjusting guard rails to maintain proper width of flangeway. The flange frogs for this installation were made by the St. Louis Frog & Switch Co., under license from the American Flange Frog & Railway Improvement Co., which latter company owns the patents granted to John E. Graham and has given license to several manufacturers. The work of improving the yard layout is under the direction of H. J. Pfeifer, chief engineer of the Terminal Railroad Association of St. Louis.

Many Rivers Studied by Geological Survey

In addition to the notable work of the Birdseye party in surveying the Colorado River last year, other parties from the Geological Survey made similar studies on other rivers throughout the western states. Although the Colorado River survey was the most important and most hazardous, it was not the only one in which the parties met with difficulties and put up with much hardship in following river courses through rugged and almost inaccessible country. Three hundred miles of the Rogue River and its tributaries, on the Pacific slope in Oregon, were surveyed and 13 dam sites and 5 reservoir sites were mapped. Much of this territory could only be reached with pack trains and boats and part of it only on foot. A hundred miles of the Klamath River in Oregon and California were mapped, completing the survey of this river and its larger tributaries. Seven dam sites and two small reservoir sites were included in this work. A reconnaissance investigation was made of the power possibilities of the Smith, Trask, Nestucca, Nehalem and Wilson Rivers in western Oregon. The western tributaries of South Platte River from Denver to the Colorado-Wyoming line were mapped as well as the Sweetwater and Encampment Rivers, in Wyoming. In Colorado and Wyoming 460 miles of river surveys were made, 14 reservoir sites and 12 dam sites mapped. Over the line in Utah several small streams in the Uinta River Basin were mapped. Some of these streams were particularly rugged and required much difficult survey work. To the north, in Montana, a survey was made for a reservoir on the south fork of the Flathead River.

Sand Bed Studies at Montebello Filters, Baltimore

Further Discussion by Abel Wolman and S. T. Powell of Article March 27 by John R. Baylis with Rejoinder by Mr. Baylis

Sand Size Cause of Troubles

By Abel Wolman and S. T. Powell
Chief Engineer and Resident Engineer, Respectively, of Maryland State Department of Health

THE OBSERVATIONS of sand-bed conditions described by John R. Baylis in *Engineering News-Record*, March 27, p. 516, have been so brilliantly made and carefully described that little room is left for critical comment. It is interesting, however, to the present writers to inquire how the data published by Mr. Baylis led him to the polite, but rather firm, sweeping away of our hypothesis as to sand-bed shrinkage (*Engineering News-Record*, July 29, 1920, p. 210) in the following terms: "But the authors have not been able to prove the correctness of this theory" (p. 520). Mr. Baylis' conclusion as to the inadequacy of our explanation of the phenomena under discussion is especially striking, since every observation reported in his own contribution is additional, brilliant and accurate confirmation of our own earlier contentions. Can it be, therefore, that his logic, rather than his facts, lead him to the abandonment of our "theory" and the substitution therefor of another hypothesis, which is a direct resultant of our own suggestions?

FILTER 11 CRACKS ALTHOUGH ITS SAND IS COARSE

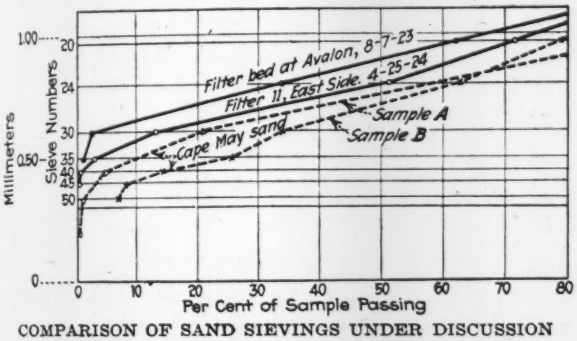
In our contribution of 1920, which incidentally included careful observations and measurements of the same beds now discussed by Mr. Baylis, we concluded that (1) sand-bed shrinkage occurred; (2) shrinkage was a function of size of sand (more particularly of specific surface area of sand); (3) shrinkage decreased abruptly in amount above a certain size of sand (when dealing with similar sands); (4) the use of larger size of sand eliminated shrinkage in beds where this phenomenon formerly occurred, without concomitant changes in any other characteristics involved in the operation of the plant. These are the hypotheses and facts presented by us.

What are the observations and statements of Mr. Baylis, which, to his mind, disprove the above conclusions? Extracts from his paper follow: (1) "The size, composition and other characteristics of the grains have little influence on the thickness of coating formed if there is no force tending to remove it, but the size has great effect on the settlement that will take place, and, due to abrasion in washing, greatly affects the amount of coating that will be retained on the grains" (p. 516). (2) "The thickest coating is usually found on the smaller grains" (p. 517). (3) "The smaller the sand grains the greater will be this tendency to adhere, due to the coating usually being thicker on the smaller grains" (p. 520). (4) "Practically all troubles from cracks and clogged places in filter beds, where the proper size sand has been used and there is an even distribution of wash-water, may be attributed to the gelatinous coating around the sand grains" (p. 521).

Mr. Baylis, therefore, discards our hypothesis that size of grain is responsible for shrinkage and cracks and substitutes his own; namely, that cracks and clogged places are due to the gelatinous coating around the sand grains, *a direct quantitative function of the size of grains* (italics ours). In other words, Mr. Baylis prefers to substitute for a cause, size of sand, a resultant, gelatinous coating, as a further cause for shrinkage. He has that right, of course, but adherence to good logic would demand that the primary cause of two secondary results should not be discarded because of the investigator's desire for a new hypothesis. After all, a new hypothesis requires more than a new statement of an old fact to warrant its complete acceptance.

Comparing Mr. Baylis' observations and statements with our own conclusions, we find little variation, if any, from our practical finding that the use of the proper size of sand will eliminate and prevent the troubles discussed. Fortunately, history after the publication of our first report amply confirms this hypothesis, since sand-bed shrinkage is negligible in most plants in Maryland, other than at Montebello, where a sand size according to the specifications noted below has been used.

The only real difference of opinion between Mr. Baylis and ourselves would probably reside in the selection of the



COMPARISON OF SAND SIEVINGS UNDER DISCUSSION

Avalon filter sand collected near surface contained numerous mud balls and had characteristic clogged places around the side walls. No. 11 sand represents vertical section from top to bottom. The bed does not keep in good condition. Cape May A sand is analysis made with State Board of Health sieves. Cape May B sand is sample of Avalon sand furnished Mr. Armstrong by Mr. Wolman. It was sieved by Mr. Baylis.

proper size of sand to use. Unfortunately, we have no way of making a comparison of his conclusion with our specification, since nowhere in his paper does he specify the size of sand by standard methods of reporting, such as effective size and uniformity coefficient. A sand of "average diameter" of 0.6 mm. is not the same as a sand with an effective size of 0.6 mm. as Mr. Baylis may have assumed in his discussions. Just what is meant by a sand of diameter of 0.6 mm. it is difficult to interpret in terms of our usual specifications by Hazen's method, using effective size and uniformity coefficient as standard units.

These observations as to size of sand in use at Montebello are especially interesting, since it is our recollection that no single bed at this plant had, in earlier years, any sand in the upper 6 in. of the unit with an *effective size* much over 0.35 mm. by standard methods of sieving. Mr. Baylis' statement, therefore, that "no sand has been found that will not form this gelatinous coating when placed in the filter beds at the Montebello filters" is accurate as far as it goes, but this statement is not equivalent, as he implies, to the conclusion that no sand of effective size greater than 0.45 mm. will result in elimination of sand bed shrinkage and cracking. One obvious explanation of why gelatinous coating, of serious importance, has never been absent at Montebello may be that a large sand has never been used (i.e. effective size 0.45 mm., uniformity coefficient 1.5). (Sievings of sand in all the beds were given in the article as originally submitted to *Engineering News-Record*. Some met the above specifications yet Mr. Baylis reported that they clogged badly.—EDITOR.)

But, when all is said and done, the real test of any hypothesis is how it works. A number of beds in Maryland, at Takoma Park, Hyattsville, Sykesville, Westport, Westminster, etc., at one time or another, showed the symptoms described by Mr. Baylis. The replacement of fine sand in these beds by the sand specified below has resulted, *in every case*, in elimination of the practical difficulties of shrinkage and cracking, independent of season, temperature, raw water character, biological action, etc. As pointed out in our earlier study, these latter associated factors modify operation, as between the same sands, but do not assume practical import in the distinction between large and small sand, insofar as shrinkage and cracking go.

With these experiences in mind, it would appear wise to suggest the equipment of a unit with a sand having the following specifications, in use by this office for the past four years:

The sand shall be specially selected and screened, clean and siliceous, composed of hard, durable grains either sharp or round, substantially free from clay, loam, dust or other foreign matter and flat particles. It shall have an effective size of approximately 0.50 mm. and have a uniformity coefficient not greater than 1.75. No sand less than 0.45 mm. and more than 0.60 mm. in size shall be used.

Upon Mr. Baylis' suggestions as to devices for preventing gelatinous film, we have no comment to make, since these deal with questions of removal of effects and not elimination of causes. Their adoption is dependent upon economic considerations and the test of time, but has no relation to the hypothesis of original cause of shrinkage.

* * *

Coarse Sand Used, but Not Effective

BY JOHN R. BAYLIS

Principal Sanitary Chemist, Montebello Filters, Baltimore, Md.

THE ORIGINAL article by Wolman and Powell (*Engineering New-Record*, July 29, 1920) conveyed the impression that they attributed, to a considerable extent, the characteristics of the sand grains, other than size, as being responsible for shrinkage. That is, with two sands of equal size and surface area there may be considerable difference in the adsorption. Quoting from their article: "It is suggested also that the existence of patches of highly adsorptive sand, of either small size or unusually active surface, may be responsible for the formation of the objectionable and tenacious mud ball with which filter operators frequently are troubled." What does "unusually active surface" mean in the above sentence? By taking us to the "strange lands of ceramics and agriculture" it also conveys the impression that they believe syneresis to be the cause of the starting of cracks. That is, the beds are pulled together and not pushed. Others with whom the article was discussed interpreted it in the same manner. These authors have not proved an unusually active surface of the sand grains or syneresis to be responsible for shrinkage, neither does my article offer proof of this part of their article. The writer regrets that he was not more specific as to the theory not proved in their excellent presentation of shrinkage.

A record of the sievings of all the filter beds was included in the original article to the editor but it required too much space for publication. The sievings of filters 4 and 10 practically comply with the suggested specifications, yet there is serious clogging in these beds. Filter 11 was reconstructed last year, and the effective size is now greater than 0.55 mm. The photograph shows that it is also clogged and that cracks have formed. The article stated that coarse sand was an aid, but even with coarse sand beds will not remain in good order under our conditions. There were cracks and clogged places around the side walls when the sand grains were coated with lime in 1917 and 1918 with an effective size above 0.60 mm. The chart shows sieving of several samples of sand. A uniform sand of about 0.60 mm. means just what it says. This size was supposed to be the ideal, and it is to be understood that a deviation will have to be made in actual practice. It was not intended to be a specification, but an object to have in view when writing specifications.

Low Typhoid Death Rate in Australia

The typhoid death rate in Australia for the year 1922 was 4 per 100,000 according to the Official Year Book of the Commonwealth of Australia. The crude general death rate for the year was 9.21 per 1,000.

Rebuilding the First Budapest Suspension Bridge

Chains and Deck Renewed After Sixty-Five Years' Service — Heavier Eyebar Chains, Movable Saddles and Accessible Anchor Bars—Strengthening the Anchorage Piers

By Joseph Beke
Budapest, Hungary

THE OLDEST fixed bridge across the Danube at Budapest, the Széchenyi suspension bridge, was built in the period of 1839-1849 to the plans of W. T. Clark. After remaining in service unchanged for more than sixty-five years, it has now been rebuilt by complete renewal of the cables and suspended structure and reinforcement of the anchorages.

While the old structure excelled among the bridges built in the same period, not only for its beauty but also for its more highly developed construction (see "An Account with Illustrations of the Suspension Bridge Across the River Danube," by W. T. Clark, London, 1852-53), its capacity was inadequate for modern traffic needs. This fact, together with defects arising from the deficiency of bridge theory and design at that early time, resulted in various troubles. In the course of years many of the cast-iron floorbeams cracked. The anchorage of the cables and their support on the towers required much attention. The bridge was so flexible as to develop alarming oscillation and sway under heavy crowds or in strong winds. Eventually, reconstruction of the bridge became inevitable.

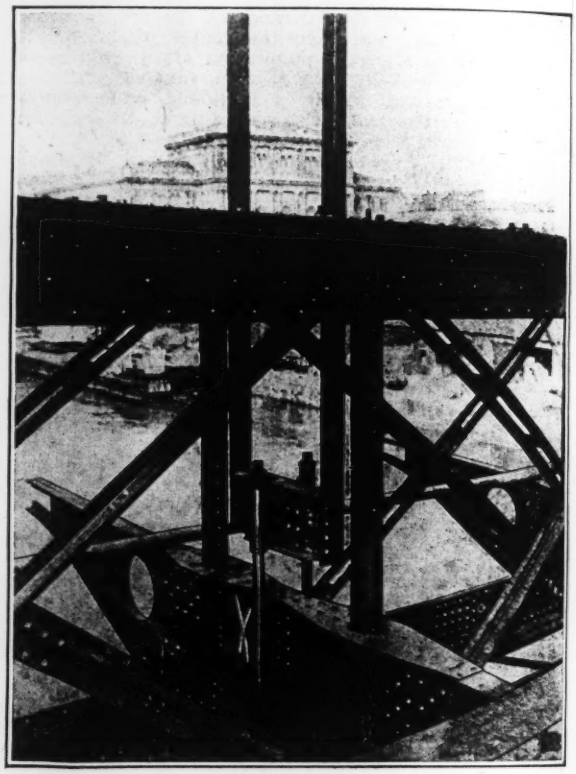
It was considered essential to maintain the original appearance of the bridge in the reconstruction. Many old traditions are connected with the bridge. Moreover, the structure had become virtually a part of the landscape, its beauty and that of the river and surroundings blending most harmoniously. Therefore, the principal form of the bridge was to be preserved and no visible alteration was to be produced in the towers and anchorages, which are of magnificent architecture and are in excellent preservation. As regards the superstructure, however, it was not practicable to retain (and merely strengthen) the suspension chains, trusses and floor, and their entire replacement was necessary. Except for towers and anchorages, therefore, a completely new structure was to be built, to outlines of the old bridge.

The main span of the bridge is 665 ft. center to center of piers; the side spans, from pier center to face of anchorage, are 288 ft. each; the length of the bridge between outer ends of anchorages is about 1,500 ft.

Just as in the old bridge, the new carrying members are two superimposed eyebar chains on either side of the roadway, with stiffening trusses suspended by hangers. The new hangers are suspension members made of two tees, with bolt hangers at the lower ends supporting the ends of the new floorbeams in flexible manner. The floorbeams are plate girders. A central system connects the bottom chords of the stiffening trusses.

The new floor was proportioned for a live-load of 26,400-lb. trucks. For the stiffening trusses and chains a uniform live-load of 82 lb. per square foot was adopted. It was unnecessary to provide for electric cars and very heavy trucks as these can cross by way of three other highway bridges elsewhere in the city, which have wider roadways. In the Széchenyi bridge the original width of the roadway could not be increased, as the suspended structure passes through the portals of the towers.

The suspension chains of the old bridge were of wrought iron, and the stiffening trusses of wood. In the new structure these parts and the lateral system are of high-carbon open-hearth steel, of ultimate

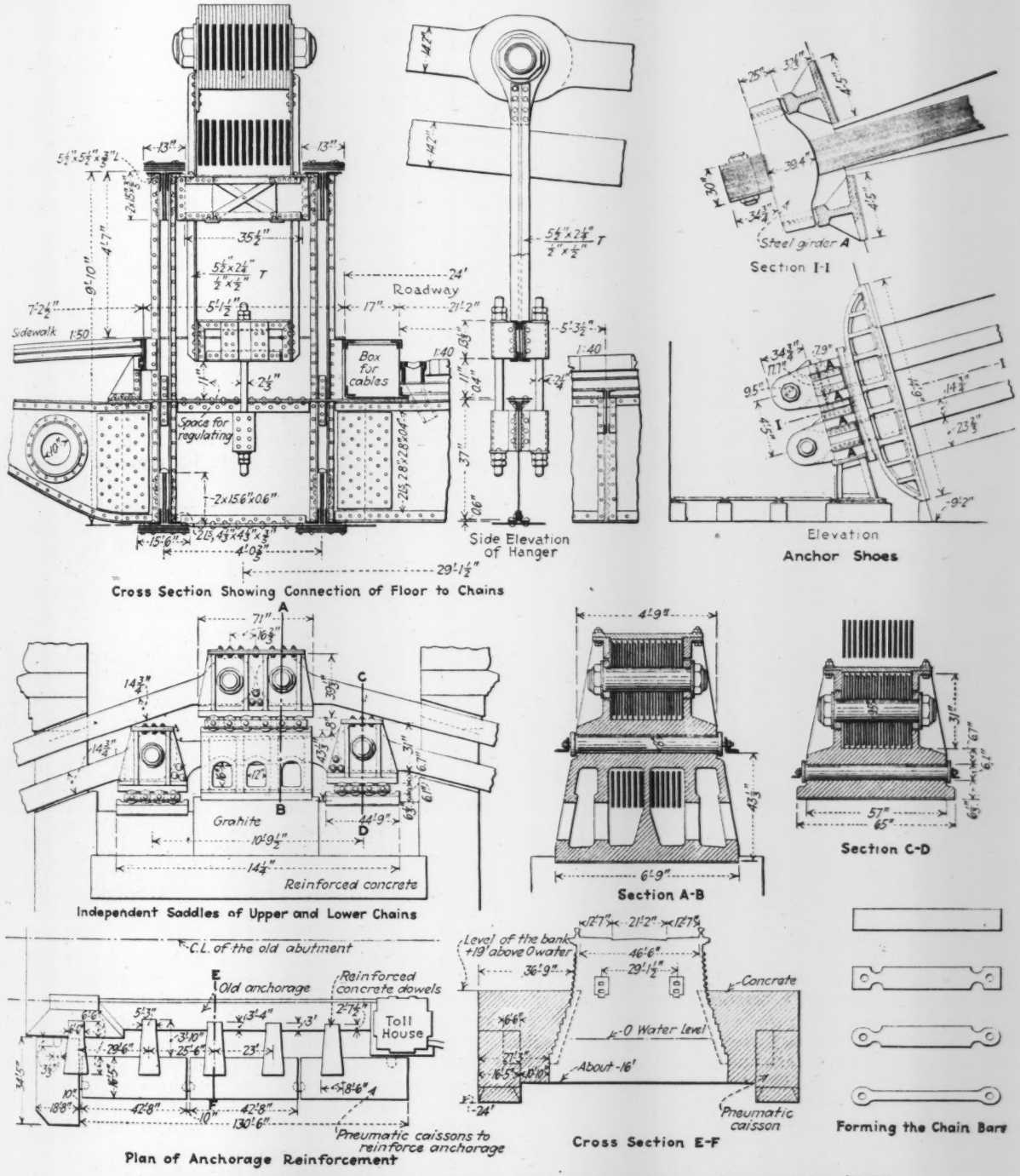


FLOORBEAM HANGER OF RECONSTRUCTED BRIDGE

strength 70,000 to 80,000 lb. per square inch and minimum elongation 20 per cent in 8 in. Other parts of the structure are of common (soft) steel, of ultimate strength 51,000 to 64,000 lb. per square inch (and corresponding minimum elongation 28 to 22 per cent), except that the tower and anchorage saddles are steel castings. Unit stresses of 20,000 lb. per square inch for the hard steel and 12,000 lb. for the soft steel were adopted for the proportioning. No impact allowance was made, although the general specifications for highway bridges for Hungary (1910) prescribe 40 per cent impact allowance for all live-loads and fix the unit stress for soft steel at 17,000 lb. per square inch.

On account of the limitations imposed by the old structure as already mentioned, the new roadway width, including the curbs (within which cable ducts are inclosed) is only 24 ft.; the cables or suspension chains are spaced 29 ft. 1½ in. apart. On either side is a sidewalk 7 ft. 2½ in. wide (instead of 6 ft. as in the old bridge), carried on floorbeam cantilever extensions. Their iron railings are designed in imitation of the old wooden balustrades.

Little change was made in the general proportions



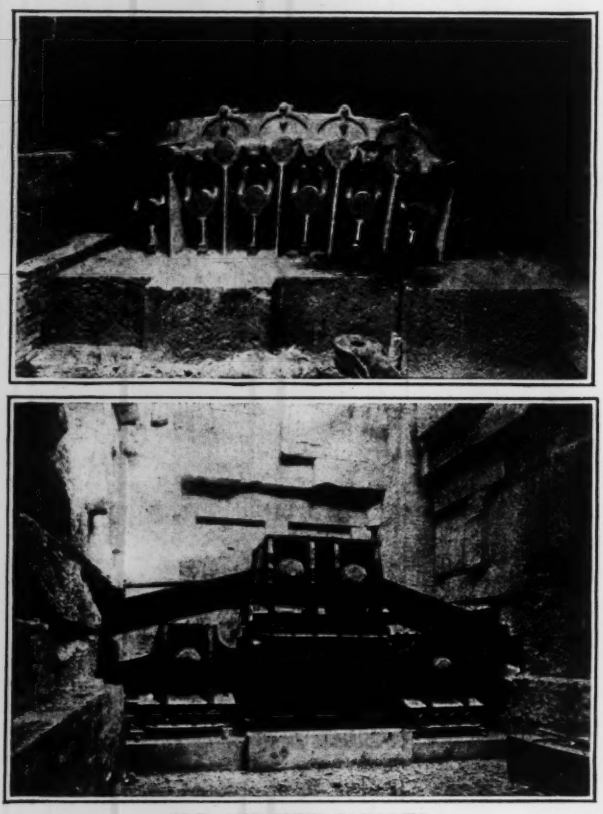
DETAILS OF RECONSTRUCTED SUSPENSION BRIDGE OVER THE DANUBE AT BUDAPEST

of the bridge. The sag of the chains in the main span is 78 ft. 7 in., or 1/13.7 of the span, nearly the same as that of the old chains. The new chains are of much larger section, however, each chain consisting of alternately 12 and 13 bars 14.8 x 1.4 in. (as compared with 10 and 11 bars, 10.25x1.028 to 1.245 in.). The cross-sectional area is thus increased by more than 60 per cent, and the strength still more on account of the higher quality of the metal. The pins connecting the eyebars are 9½ in. in diameter, while the old ones were 4½ in.

At the supports of the old chains on the towers there was no evidence that the saddles ever moved. The new saddles have been so detailed that it is believed that they will move under load and temperature variations without excessive resistance. Upper and lower chains have separate supports and move independently. At the front of the abutment, where the chains change direction as they enter the tunnel leading to the anchor bed plates, cast-steel rockers (supporting the two chains separately) make provision for horizontal movement due to stretch of the anchorage portion.

The new anchorage arrangement makes the anchor members accessible and distributes the load. In the old structure the anchor chains were almost inaccessible and therefore liable to injury by rust, and excessive load was thrown on the masonry at the edge of the chain tunnel. The arrangement now is similar to that in the Elizabeth bridge at Budapest, designed about twenty-five years ago. The design as originated there found later acceptance by other engineers, as in the competition for a highway bridge across the Rhine at Cologne, where one of the plans exhibits a close copy of that construction.

The stiffening trusses are quite similar in outline to the old wooden trusses. On account of the limits imposed by the old masonry towers, it was not possible to make the trusses continuous over main and side spans, as applied in the Elizabeth bridge, and therefore independent trusses are used, of spans 279 ft., 641 ft., 279 ft. The truss depth is about 1/63 of the main span length; it was not possible to go as high as the customary ratio of about 1/50 without radically changing the external appearance of the bridge.



OLD AND NEW SADDLES

Support for the stiffening trusses and lateral system at piers and anchorages was provided by cutting into the masonry; the old wooden trusses were not supported at these points.

Extensive foundation was necessary at the abutments, since increased sliding resistance had to be provided on account of the increased chain pull. To avoid changing the appearance of the anchorages this reinforcement had to be provided below river level; and as the river profile made it impracticable to build buttresses at the front of the anchorage, extensions of the foundations were built on either side of the anchorage, below ground level, bonded to the original anchorage foundations.

A line of pneumatic caissons was sunk along either side of the foundation and connected to it by means of reinforced-concrete extensions which are notched into vertical recesses cut in the old masonry. A weight of about 13,000 cu.yd. of concrete was thus added to each anchorage, to provide sliding resistance.

In carrying out this part of the work the caissons were sunk first, as the work here had to be carried below the level of the old anchorage footings. The concrete cap work was done under protection of the cofferdam formed by the caissons, after the joints between the caissons had been sealed by concrete keys sunk under pneumatic pressure. The whole foundation extension is so reinforced and joggled together as to insure the integral action of the mass.

In the demolition of the old superstructure and the erection of the new, fixed falsework was employed in all three spans. The main-span falsework contained three truss-span openings for navigation, each of 160 ft.

All falsework piles had to be removed before the breaking up of the ice in the Danube, and this limited the entire program to the short period March to December, 1914. This rapid construction was successfully accomplished. Floating falsework was used for all remaining work, including the erection of the stiffening trusses in the main span, done in the following year. In November, 1915, the new bridge was opened to traffic, after twenty-one months' interruption.

A serious accident interrupted the work during the erection of the chains. A scow that broke away from its moorings above the bridge one night floated downstream and, colliding with the falsework in one of the side spans, carried away a large part of this falsework, as well as a traveler supported on it and a large number of eyebars ready for erection in the chains. At about the same time (end of July, 1914) the war broke out, which made the completion of the work problematical even without the accident mentioned. In spite of both discouragements, however, by great effort and systematic organization of the work the erection was carried out according to program, and the time fixed for the removal of the falsework was met.

In October, 1915, a load test of the bridge was carried out, with satisfactory results. Under a load of about 1,000 tons equally distributed over the main span, the mid-span deflection was 13½ in. The deflection due to temperature increase was about ½ in. per degree centigrade. These results were closely in accord with the calculated values. Further, all important parts of the structure were carefully observed under the load test and no irregularity of action was noticed. No movement of the anchorages could be detected.

Although the relatively small depth of the stiffening trusses makes the calculated deflections of the bridge under partial loading rather considerable, the bridge proved satisfactorily stiff in practice under all traffic conditions and does not oscillate even in strong wind.

All material used in the reconstruction was produced in Hungary, except some granite which was obtained from Austria. The eyebars for the new chains were produced in the government steel works at Diósgyör; seventy-five years ago, the old wrought-iron chains had to be imported from England, being made by Howard & Ravenhill of Rotherhithe. All other parts of the structure were fabricated in the government machine works

at Budapest, of material produced at the steel works of Diósgyör and Zólyombrezó.

The total weight of the new steel superstructure is 5,200 tons. The cost of rebuilding, including the reinforcement of the anchorages, amounted to about 6,500,000 k., equivalent to $1,300,000 at that time.

The work was designed and its execution directed by the Highway Bridge Department of the Hungarian Ministry of Commerce.

As in the case of the Elizabeth bridge, built in 1899 to 1900, the chains for the new bridge were cut from plates of the width of the head, a process described in the Journal of the Hungarian Society of Engineers and Architects (*Magyar Mérnök-és Epitész-Egylet Közlönye*) 1900, p. 49, and in the *Zeitschrift des Vereines deutscher Ingenieure*, 1920, p. 558.

Model of Niagara to Demonstrate Flow Control

Variations of Draft Simulate Power Use of Water and Show the Effect on Scenic Beauty of the Falls

IN ORDER to demonstrate the effect on the flow of water over Niagara Falls of the varying drafts for power purposes in use and proposed, the Niagara Falls Power Co., of Niagara Falls, N. Y., has built in its grounds near the falls a large size model of the falls which faithfully reproduces not only the topography but the flow of water down the Niagara River and over the cataract. The model is about 100x125 ft. in plan and on a horizontal scale of 1 to 100. The vertical scale is somewhat less than that in order that the perspective effect of a nearby spectator may be maintained. As shown in the accompanying view, the model is a remarkably exact copy of the natural falls especially in the appearance of the flow of the water over the cataract and in the upstream rapids.

VIEW OF NIAGARA FALLS AND OF MODEL TO DEMONSTRATE FLOW CONTROL

On left: Niagara Falls from a point in the air above the Canadian shore. On right: The 100 x 125-ft. model of Niagara Falls from a point of similar vantage.

The object of this model is to demonstrate, first, the effect on the scenic quality of the falls by varying the draft of water above the falls for power purposes, and, second, to show the possibilities of remedial measures above the falls in the way of weirs or similar obstructions, the intention of which is to spread the flow of water over the brink in such manner as to increase the scenic qualities under lowered flow.

The model is filled with water from a pump which fills the reservoir simulating the Niagara River above the falls. In this section there are reproduced in exact scale the various power houses on either side of the river. These miniature power houses have outlets with gages to measure the flow through them so that the draft at each replica power house can be made equal to that which it now takes or which may be proposed under any scheme. A demonstration of the model consists in showing first the full flow of the river as it is at present and then the flow of the river under increased drafts through the various power houses. The effect of these increased drafts shows perceptibly in the amount of flow over the falls and more especially in the distribution of that flow. However, a second use of the model, as noted above, is to demonstrate the effect of remedial measures, so in the demonstration there are available miniature weirs and artificial islands which are placed in various positions above the brink of the Canadian Falls and also at the upper end of Goat Island and the diminished flow thereby distributed so as to be uniform across the entire brink.

The Niagara Falls Power Co. has built this model partly for demonstration purposes and partly for experimental purposes. They are not offering at the present time any solution of the problem of how best to distribute a diminished flow to increase scenic effect, but they offer the model to any one who has an idea of method of improvement so that the method may be tested out experimentally. The model was built under the direction of John L. Harper, vice-president and chief engineer of the power company, after the hydraulic calculations of Norman R. Gibson, of the company.

Health Board Would Penalize City

An attempt to collect a penalty of $20,500 from the city of Hull, Quebec, is being made by the Quebec Provincial Board of Health for the failure of the city named to install a mechanical water filtration plant as ordered by the board in 1916. The suit was begun in 1917. The city held that the expenditure ($170,000) was unwarranted, says *The Canadian Engineer*, "both from the city's financial condition and the fact that a system of water chlorination had been installed which was proving effective." The lower court ruled against the city. On appeal to the Court of Review of Montreal, the judgment of the lower court was sustained, but the city has "made no effort," says the authority quoted above, "either to meet the judgment or comply with the board's order to install the filtration plant."

Bituminous Macadam Roads For Heavy Traffic

Render Economical Service Under Traffic of 5,000 Vehicles a Day—Good Design, Construction and Maintenance Essential

By I. W. Patterson
Chief Engineer, Rhode Island State Board of Public Roads, Providence, R. I.

Rhode Island roads of bituminous macadam are carrying a traffic so heavy at an up-keep cost so low as to challenge the admiration of highway engineers. How is this excellent service being secured? An answer is indicated in this paper read at this year's Annual Conference on Highway Engineering, University of Michigan, Ann Arbor. The paper also discussed bituminous surface treatments but only the section on bituminous macadam is published. A previous important discussion concerning Rhode Island bituminous roads was published in "Engineering News-Record," Dec. 11-18, 1919, p. 976.—Editor.

THE PRACTICE of constructing and maintaining bituminous macadam pavements is extremely variable. In discussing pavements of this type, therefore, we must not presume that we are discussing a type of pavement which is standardized in construction and in maintenance to the extent to which many of the higher types are standardized. We find numerous instances of dismal failure of bituminous macadam pavements under comparatively light traffic. Upon the other hand, we find certain instances of the rendering of every economical service of pavements of this class under heavy traffic. In connection with a discussion of the traffic limitations of this class of pavement, therefore, the lack of standardization and the lack of uniformity in results secured present difficult problems.

COSTS OF BITUMINOUS MACADAM PAVEMENTS IN RHODE ISLAND

Year of Construction	Prevailing Width, Ft.	Average Cost Per Mile†	Average Maintenance Cost per Mile per Year††
1913	14	$7,660.27	$153.35
1915	18	8,417.65	112.82
1916	18	12,067.83	217.01
1917	18	17,207.83	186.85
1918	18	18,333.53	114.35
1919	18	18,616.07	103.04
1920	18	23,730.64	31.33

† Cost of pavement only, exclusive of costs of grading, foundation and drainage.
†† Cost of maintenance of pavement only.

Results with bituminous macadam in Rhode Island fail to disclose any definite relationship between volume of traffic and cost of maintenance. This would appear to indicate of course that features of design, construction and maintenance are of tremendous importance so far as service rendered by the pavements is concerned. In our attempt to determine the limitations of bituminous macadam upon our state highway system in Rhode Island, very frequently we are confronted by paradoxes such as the lowest maintenance costs upon the projects carrying the greatest traffic. This study, however, leads to the conclusion that bituminous macadam pavements are capable of standing very heavy traffic provided an intensive study of these pavements succeeds in eliminating a number of very common faults both in connection with construction and in connection with maintenance. The accompanying table showing costs of bituminous macadam pavements in Rhode Island is of interest.

Two of the sections built in 1913 were resurfacing projects over old macadam. These sections were replaced during 1923. Except for this replacement of two very cheap jobs, all of our bituminous macadam is carrying traffic successfully.

The bituminous macadam pavements of Rhode Island are called upon to carry traffic varying from approximately 1,000 vehicles of all classes per day to traffic of approximately 7,000 vehicles of all classes per day during seven months of each year. Since the state is primarily industrial throughout and since the population is dense, the traffic over the roads of course is heavy during the winter months. Snow removal upon all state roads is considered to be absolutely essential. Of this total traffic, motor trucks constitute from 200 to 600 vehicles per day, and this traffic varies little with the seasons.

As an indication that refinement of method of construction and maintenance perhaps is of the greatest importance in the case of bituminous macadam pavements, it is interesting to compare the costs of maintenance of the projects completed during very recent years with the costs of maintenance of the projects completed previously. For three years following 1916 the bituminous macadam pavements constructed during that year cost an average of $77.50 per mile per year for maintenance. The projects constructed during 1920 cost during the following three years for maintenance an average of $31.33 per mile per year. Traffic over the roads of course increased greatly during the period from 1916 to 1920 and this illustration is offered of the possibilities afforded for the development of rational methods of construction of bituminous macadam pavements to the end that the very common faults of these pavements may be eliminated. The lower maintenance costs of the projects completed in 1920 we believe is attributable only to greater care in connection with the innumerable details of construction.

Maintenance Results—Questionable methods of maintenance also, we believe, account for a great deal of variation in results secured from the use of bituminous macadam pavements. It is the practice in Rhode Island to reduce the number of resealing operations to a minimum. Progressive corrugation of bituminous macadam pavements we believe is stimulated greatly by the application of excess of bitumen upon the surface. Therefore, local resealing only is resorted to until a large percentage of the total area displays evidence of a need for resealing. Several of the projects constructed in 1913 yet have not been resealed except locally. Under our plan of maintenance the materials and methods employed in original construction are adhered to strictly. This practice is followed because of our belief that it promotes the preservation of uniformity of the surface and thereby adds to the economical life of the pavement. We do not favor any plan of maintenance which tends toward lack of uniformity of surface.

Apparently we must consider that resealing of bituminous macadam surfaces is a necessity sooner or later. In planning such surface treatments, however, it appears that the greatest care must be taken in regard to selection of materials and in regard to the methods and amounts of application. Surface treatment of bituminous macadam pavements judiciously carried out appears to restore these pavements to their original condition very effectively.

Foundation weakness many times limits directly the service rendered by bituminous macadam pavements. The structural strength of such pavements is negligible, so it cannot be presumed that the pavements are capable of carrying traffic successfully over unstable subsoil without careful attention to the foundation problem. It is true, however, that these pavements are capable of withstanding without apparent serious damage considerable distortion due to frost action. For that reason it does not appear to be necessary in the design absolutely to eliminate all effect of frost action upon the pavement. So-called insulating layers of permeable material directly below the pavement have been found to be very effective over heavy, retentive subsoil.

It appears also to be essential to make a careful study of the problem of the correlation of the binder to the quality of crushed stone. Binders which produce excellent results with certain rock give mediocre or even poor results when combined with other types of rock. Research into this phase of bituminous macadam pavements perhaps would result in the elimination of much of the variation in results secured at present.

So far as results in Rhode Island are concerned, it appears that bituminous macadam pavements 18 ft. or 20 ft. in width will render economical service when subjected to traffic in excess of 5,000 vehicles per day. In order for pavements to carry that amount of traffic successfully, however, more attention to the details of design, construction and maintenance is necessary than is given in usual practice.

Evaluation of Pump Bids for Chicago's Largest Station

First Costs, Steam Consumption and Capital Charges Compared—Allowances Made for Variations in Size of Building

WHEN THE Western Ave. 320-m.g.d. compound turbine-driven centrifugal pumping station is completed in Chicago, it will be the last word in equipment. Contracts were let May 9 for four De Laval 50- to 80-m.g.d. units supplied with steam from four 600-hp. boilers having a 100 to 200 per cent overload rating and steam pressures of 315 lb. and 225 deg. superheat, a total temperature of 650 deg. Steam turbine and electric motor-driven centrifugal pumps, triple expansion, reciprocating and Diesel oil machines were considered, and their relative merits from a financial and continuous service point of view compared. After giving these various points due weight, it was concluded that steam turbine-driven centrifugal units would best meet the financial, operating and service conditions at this station.

Evaluation of the bids for the pumps for this station, as outlined by John Ericson, city engineer, in transmitting the canvass of bids to Col. A. A. Sprague, commissioner of public works, considered price bid, average yearly operating costs based on guaranteed duties, design and construction of the various parts of the units, past record of similar machinery, responsibility of bidders and relative cost of building.

BID COMPARISON OF 80-M.G.D. STEAM TURBINE-DRIVEN CENTRIFUGAL PUMPS FOR WESTERN AVE. STATION

Bidders	De Laval A Single Barrel Type	De Laval B Compound Type	Allis-Chalmers	Worthington
Price bid	$294,000	$334,760	$263,800	$305,753
Guaranteed steam consumption for each unit per hour, lb.	14,446	14,186	16,123	14,455
Excess steam per each unit, lb.	260	0	1,937	269
Value at $28.25 per lb. per unit	$7,345	0	$54,720	$7,599
Value of excess steam consumption, 3 units	$22,035	0	$164,161	$22,798
Comparative price	$316,035	$334,760	$427,961	$328,551

Four bids were received: DeLaval impulse type, with single barrel units, DeLaval impulse type, with compound units, Allis-Chalmers reaction type with single barrel units and Worthington impulse type with single barrel units.

The following is quoted from the report:

While the prices bid in general govern acceptance of bids in the cases of ordinary contracts, in the case of machinery of this kind the situation, however, is different. The bidders are required to guarantee certain efficiencies of the respective machines they offer. In other words, they guarantee the number of pounds of steam that their units will require to perform the work in pumping a stipulated number of millions of gallons of water against stated heads under various carefully determined conditions at the particular station.

As the capitalized value of each pound of steam, which is capable of close determination, amounts to a considerable sum of money, being in this case determined at $28.25 with the average price of coal assumed at $3.75 per ton including handling, it is evident that the guaranteed steam consumption in each case must be considered in connection with the price bid for the machinery.

A different way to determine the relative value to the city of the various machines offered under the same conditions is to determine what the actual yearly comparative fixed and operating expenses will be to the city in each case, as far as there is any variation in these costs. This comparison is shown in the following tabulation:

Bidders	De Laval A	De Laval B	Allis-Chalmers	Worthington
Price bid	$294,000	$334,760	$263,800	$305,753
Steam per hour per unit, lb.	14,446	14,186	16,123	14,455
Interest on investment at 4½ per cent	$13,230	$15,064	$11,871	$13,759
Sinking fund to liquidate capital in 20 years	$9,370	$10,669	$8,407	$9,744
Cost of steam 21,720 turbine hr.	$94,130	$92,436	$105,057	$94,189
Yearly expense	$116,730	$118,169	$125,335	$117,692
Difference	0	$1,439	$8,605	$962

Each bidder being a responsible concern and all offering machinery of recognized excellence and reputation, any particular value of one bidder's proposal over the other need not here be considered, except as between the two De Laval proposals, which will be referred to later. A careful estimate has been made of the cost of building required for each type of machinery offered, which is of varying length, and is as follows:

Bidders	De Laval A	De Laval B	Allis-Chalmers	Worthington
Relative cost of building	$514,428	$486,280	$561,910	$561,910
Difference	28,148	0	75,630	75,630
Comparative cost of machinery	294,000	312,718	405,934	306,514
Total comparative cost.	$322,148	312,718	481,564	434,054
Rank of bid	2	1	4	3

It is evident, therefore, when considering the cost of the building in connection with the evaluated cost of the machinery offered by the various bidders that proposal B of the De Laval Steam Turbine Co. proves to be the most advantageous to the city as to cost. This company is the lowest bidder whether the machinery alone is considered or the machinery in connection with the proposed building. Its proposal B, consisting of units with compound steam turbines as prime movers, offers machines that are of greater power, are better constructed, more rugged and compact, safer and more economical than those offered in its proposal A. The contract was in consequence awarded to the De Laval Steam Turbine Co. on its proposal B.

Stilling Chambers for Akron Sewage-Works

In place of separate units consisting of grit chambers, grease skimmers and fine screens at the new sewage-works for Akron, Ohio, it is proposed to use two stilling or relatively large detritus chambers with provision for sweeping the grease into a side chamber by revolving arms and for collecting the coarser settleable solids by a revolving arm, suction pipe, and centrifugal pumps, the arms at the bottom of the tank being similar to the revolving devices in the Dorr tank. A stilling effect in the tank will bring the lighter material like grease to the top, from which it will be swept into the bay. The sand, gravel, and liquid matter removed by the revolving arms and centrifugal pumps will be discharged into troughs similar to grit chambers. Here the sand and gravel will be deposited. The liquid matter will be passed through fine screens and into the Imhoff tanks. The grease and fine screenings will go to an incinerator and the sand and grit will be disposed of for filling. Preliminary studies indicate that a combined detention period of 15 min. during the maximum flow of 94 m.g.d. will be sufficient, and that only 6.6 m.g.d. will have to be passed through the grit troughs and fine screens. The 87.4 m.g.d. of sewage will be discharged through an opening midway down the side wall of the stilling tank into an effluent channel leading to the Imhoff tanks. For the foregoing information we are indebted to J. E. Root, sewerage engineer, Akron, Ohio, and Harrison P. Eddy, consulting engineer, Boston, the latter employed by the city of Akron in connection with the new sewage-works.

Classification and Definition of Earth Dam Types

Descriptions Based on Construction Methods and Materials Employed—Distinctive Features Retained

By J. Albert Holmes
Hydraulic Engineer, Chicago, Ill.

EARTH DAMS of many types have been and are being built by many methods in North, Central and South America and in Britain and the British possessions and Europe. As the various types and methods developed, distinctive names and terms were applied descriptive of some particular feature or manner of construction. Definitions of the earlier types were given by Schuyler and Bassell nearly twenty years ago and by Hageman more recently. At the present time there is a discussion going on as to the difference between two types of hydraulic-fill dams, one of which has been developed since Schuyler and Bassell gave their definitions, and, consequently, it seems opportune to attempt to define all the various types in a concise and descriptive manner.

In spite of the fact that none of the above engineers agreed in their classification of types and that types merge one into another, there are numerous distinctive examples of each type and it would seem well to retain and emphasize the distinction.

Th following descriptions are based on methods of construction and materials employed. A term in more or less common use is applied to each type and a concise definition given.

Of type 1, earthen, the Tabeaud dam in California is an excellent example of a homogeneous structure in which great care was taken to consolidate the material and with excellent results. It, however, has a puddle face for a portion of its height.

The Belle Fourche dam, South Dakota, is of this type and very compact. The usual method of consolidating is to place in thin layers then wet and roll. Another method often used when the material is suitable is to place in thicker layers and irrigate as at Mystic Lake dam in Montana and the diversion dam at Wichita Falls, Texas, and by dumping into a pool as at Marshall Lake dam in Colorado.

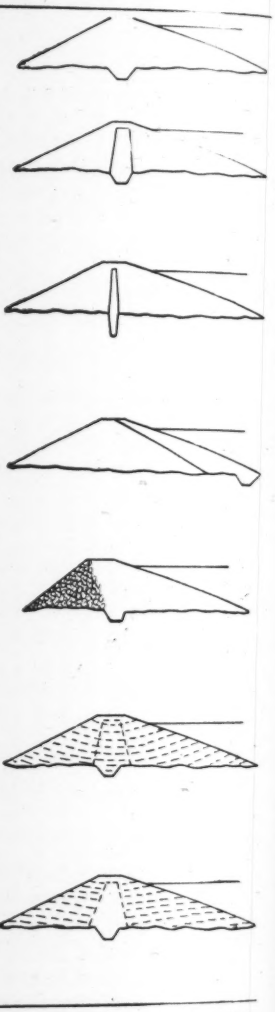
Type 2, puddle core, is the type used most extensively by British engineers, examples of which are the Yarrow, England; Llannefydd, Wales; and Dodder, Ireland. Of American dams, Druid Lake at Baltimore, Md., is an early example. Pilarcitos and San Andres, California, have puddle cores and the North Dike of the Wachusett, Mass., and Scituate, Rhode Island, dams have large rolled cores.

Type 3, masonry core, is represented by many New England dams, examples of which are the Sudbury, Mass., Reservoir 5 dam, the Croton Valley dams and more recently the Ashokan reservoir dikes in New York.

The Arrowhead dam in California, and Tieton in Washington have masonry cores. The embankments of these latter dams were placed by the semi-hydraulic method, the other dams have the earthen type, mainly homogeneous as in the Ashokan dikes.

Type 4, puddle face, is often cited as the ideal arrangement of materials, i.e., the impervious portion on the water face, supported by pervious materials, but its use is infrequent. Monument Creek dam in Colorado is a good example of this type. Others are Spring Run dam 2 in Colorado and Lahontan in Nevada.

Type 5, rock and earth, is illustrated by the Avalon, New Mexico, dam, by the Milner dams in Idaho in which the earth was placed by the hydraulic-fill method,



Type 1. Earthen. A dam in which the earth is homogeneous throughout.

Type 2. Puddle Core. A dam having a puddled or rolled core of clay or selected material. The supporting dikes may or may not be similarly homogeneous or impervious.

Type 3. Masonry Core. A dam having a core of stone, concrete or other masonry, sometimes supplemented by a timber or steel diaphragm. The supporting dikes may or may not be homogeneous or impervious.

Type 4. Puddle Face. A dam having puddled clay or selected material on its waterface. The remainder of the structure may or may not be homogeneous or impervious.

Type 5. Rock and Earth. A dam having a downstream portion of loose rock. The remainder of the structure may be homogeneous earth mass or an hydraulic or semi-hydraulic fill.

Type 6. Hydraulic-Fill. A dam in the construction of which earth, gravel and rock are transported to, segregated, placed and consolidated in the structure by the agency of water.

Type 7. Semi-Hydraulic-Fill. A dam in the construction of which earth, gravel and rock are transported to the structure in a dry condition and there segregated, placed and consolidated by the agency of water.

and the Sanches in Colorado, where the rock fill is backed by an earthen or rolled fill.

Type 6, hydraulic-fill. Four of the Necaxa, Mexico, dams are of this type, numerous dams in the western states, in the Miami Valley in Ohio, and the Quemahoning in Pennsylvania, are examples of hydraulic-fill structures in the eastern states. A more recent construction is the main dam at Wichita Falls, Tex.

By controlling the amount going in or by wasting a portion of the fine material, the extent and character of the core can be kept within certain limits. This is desirable and is being done in recent practice.

Of type 7, semi-hydraulic-fill, there are the Bumping Lake, Washington, dam; Willow River, Oregon; Henshaw, California; the great dams at Bridgewater, North Carolina, the Somerset in Vermont, and the high dam at Davis Bridge in Vermont. By this method the extent and character of the core is controlled by the amount of fine material removed by sluicing from the outer dikes.

Compensation of Practising Engineers: A Critical Study

Merits and Disadvantages of Various Systems of Payment for Service—Per Diem Basis for Purely Consulting Practice and Bonus and Penalty for Other Independent Work Recommended

By Clinton L. Bogert
Sanborn and Bogert, Civil Engineers, New York City

RECENT publication of an article wherein a member of the staff of one of our technical schools develops lengthy mathematical expressions for use in the design of a small-sized municipal structure revives the question of competition between men practising engineering as an avocation and those to whom it means sole income. This leads to the subsequent reflection on the barren monetary return to an engineer undertaking such a design on a fee basis if deprived of the clerical assistance of the senior class. The following paragraphs represent merely a thinking through of the fee situation, with the suggestion of adjusted remuneration, and the notes should not be interpreted as an attempt to upset any present practices among practising engineers.

Irrespective of titles, an engineer may receive his compensation in the form of a salary if the duration of the engagement warrants it, or a sum termed a "fee" if his engagement is intermittent or brief. In the first case he looks to an employer for his money; in the second, to a client. The distinction is barely perceptible. Many cities and corporations have men with the title of consulting engineer (*Engineering News-Record*, April 19, 1917, p. 138) on their pay-rolls, who get a salary in lieu of a fee.

Functions of the Engineer—The function of a consulting engineer as defined by Alvord is to apply his special knowledge to the review of plans prepared by the designing engineer, to expert testimony, original investigations and to valuations. Very few consulting engineers devote their whole time to purely consultant work; the functions of a practising engineer are performed when necessity arises. Our discussion concerns engineers in this capacity working on a fee.

The function of a practising engineer is the production of a safe structure, adequate for the service and at a minimum cost. His reputation will be, and his compensation should be, commensurate with his ability to fulfill this obligation. The ultimate question is, then, one of proper compensation. Let us strip the subject of useless verbiage, by assuming at the outset that the engineer is necessarily interested in earning a competence from his professional activities, and that all parties herein mentioned are free from dishonest proclivities. Corollary to this, we may add that of two designs, of equal safety and adequacy, the engineer would prefer to see that one executed which would yield him the greater financial return. To what expense is an engineer justified in going to produce for his client a structure costing less? The answer depends on the method of compensation. Cases are known to the writer wherein the value of the hours spent in reducing the cost of a structure was considerably greater than the saving.

Compensation by Percentage of Final Cost—Under a system of compensation by percentage of final cost, the engineer receives a stipulated percentage (*Engineering News-Record*, Nov. 11, 1920, p. 941, and April 21, 1921, p. 671) of the value of the construction work certified as done, or a percentage of the estimate of cost. The greater the cost of the work, the greater will be the compensation, although gradation in rates as the value of the work increases keeps this below a straight-line increase.

This form of compensation is common in the business world; and lawyers often base their fees on the amount involved. Its universal use is the chief commendation for it. The expression of the engineering cost as a percentage is a convenience in budget-making. A further advantage inherent in the percentage basis is the safeguard to the municipality since an engineer zealous for a return engagement and jealous of his good reputation will be anxious to keep costs within bounds which will not lead to the rejection of bids, or which cannot be effectively challenged in open meeting. Against these advantages, should be balanced six phases which lead to unfairness to one party or the other, and to possible disputes.

(A) *Incentive to Ultimate Economy Lacking*—The engineer has no high incentive to keep down costs to the last penny. The more time he devotes to computations beyond those necessary to satisfy himself as to the safety, adequacy and practicability of his design, the larger his overhead expenses are becoming, and, if he succeeds in cutting down the construction costs, the less return he is assuring himself. There is in such a proposition an element which is contrary to human nature.

(B) *Project Never Built*—A project never built is never a professional asset to an engineer; yet there are few drafting-room files of practising engineers which are not the morgues for many well-executed plans which never progressed beyond the blueprint stage. The compensation for these abandoned projects often is a matter of dispute, especially when the abandonment has been the subject of an election contest, and the bill for design is presented to the opponents of the project. If the engineer is astute enough to be working under a well-considered contract, he will receive some compensation for the plans. Since the cost of the report, plans and specifications constitutes the major expense to the engineer, the fee stipulated in the contract often barely requites him for his overhead, and he looks to the additional fee resulting from supervision of construction to balance his account. A contract should be so worded that the engineer is properly paid for plans of a dead project. A case is known wherein an engineer had to wait months for his fee because his contract provided for payment for designs on the basis of the "lowest bid price." Due to peculiar local conditions, no bids were received, and the contract was re-advertised; after the second opening of bids, the engineer was paid.

(C) *Compensation Disproportionate to the Work*—The designing engineer often has to spend a large

amount of time on a small job. For instance, the designing expense is about the same for a 0.5-m.g.d. water-filtration plant as for a 1-m.g.d. plant. Yet the engineer's compensation for one is a great deal less than for the other. On a system of water pipe costing $50,000 the designing work occupies but a few hours, whereas on a filter plant costing the same amount a great deal more designing and more exhaustive specifications are required. Yet, on the percentage basis, his fee is the same for one as for the other. Again, on many projects an engineer can make use of standard details or revamp an old design. This procedure probably balances up for the inequalities of the situations outlined above.

(D) *Changes in Contract Requirements*—After a contract is let, a required change of route or other conditions may necessitate considerable modification of the drawings. If the engineer is not safeguarded by a clause in his contract, he will make such changes at a loss. Again, a state department of health may promulgate new rules subsequent to the beginning of the designs, requiring the engineer to scrap some work, through no fault of his own. Such exigencies can be taken care of in his contract.

(E) *Extra Work*—There is a chance for contention with the powers that be as to what shall be considered the cost when figuring the engineers' compensation. If extras creep into the work (a not unheard-of thing on small-town work), some councilman will object to including this in the total to form the basis for payment of the engineer, on the ground that the engineer may have allowed this extra to boost his own fee, ignoring the expense of supervising this extra work. It is petty but disturbing and happens even to the most dignified of engineers.

(F) *Tardy Completion of Work*—Engineers have had to chalk up a loss against a fee when the work is let to some incompetent contractor (sometimes chosen against the engineer's advice) who lets the work drag along interminably. During this prolonged period, the engineer's contract and pride in the job require him to keep an inspector on hand and to visit the work periodically himself. His limited fee is not destined to meet such conditions.

To sum up, there seem to be six factors (A to F) that militate against the percentage basis as being 100 per cent fair to either the municipality or the engineer. Many chances for strained relations are afforded. These always hurt public work. Some of these difficulties may be minimized by a carefully-worded working agreement; others are inherent in the system and can neither be eradicated nor removed. The worst difficulty is listed as (A). The scheme suggested under the bonus plan meets it squarely.

Per Diem Rate—The per diem basis for compensation is now in vogue for such purely consultant functions as expert testimony, valuations, original investigations and preliminary reports. For these, such a basis seems logical. But for reports and other engineering in connection with a construction project, it is of questionable merit. Under this system the engineer charges an agreed amount per day for his services, another for his assistants and a third charge for expenses. When a practising engineer is operating under this form of fee, he is spurred to produce for his client the best possible work for the least money, so that he may be in line for a return engagement.

Many points of friction with municipal councils are obvious when a practising engineer works under such an agreement. The charges for assistants are often open to argument. Councils fail to realize that a $200 draftsman costs an employer nearly $235 a month to employ, when there is prorated to him his share of the overhead expenses, including his vacation. Again, expense accounts may be disagreeably scrutinized by a hostile legislator, who will probably object to the inclusion of bills for such things as printing and blueprinting.

When engineers work on a per diem basis, they generally stipulate that a seven-hour day is intended. Oftentimes drawings and specifications have to be put out on short notice which involves overtime and the engineer legitimately counts every seven hours as a day. When a member of the town board discovers that on one calendar day the itemized bill calls for two days' pay, which is legitimate if fourteen hours were required on said day, a long discussion ensues.

When plans have to be approved by an administrative body, such as a river and harbor commission, modifications are often required after the drawings have been submitted for approval. Charges for this additional time afford opportunity for a member of the opposition to question the competency of the engineer.

Municipal ordinances often provide for the retaining of a consulting engineer at so much per day for a definite number of days per year, thereby safeguarding the budgetary requirements. Obviously, cases may arise where such a limit works an injustice to public work.

Theoretically, it would appear that the per diem fee for practising engineers has fewer disadvantages than the percentage system. Practically, it probably does not net so much in remuneration or it would long ago have superseded the commission system in all lines of business. Undoubtedly the latter is preferred in that costs can be expressed in percentage of the total, whereas with the per diem rate, the engineering expense may bear no established relation to the cost of the work.

The Flat Rate (Fixed Sum)—The flat rate (fixed sum) system has been applied to all sorts of engineering activities, even to expert testimony. It is financially advantageous to the municipality in that it can be readily budgeted. But, in the last analysis, this asset may turn to a debit, as any man, even an engineer, when he finds that he has the poor end of an agreement, is tempted to hedge and skimp. A flat rate is only fair to all concerned when the exact nature of the work and the time required to perform it, are known. The greatest objection to an engineer's doing business perpetually on the flat rate basis is that each assignment may involve renewed bickering with the council as to compensation. The element of bargaining—a disagreeable feature, and one that engineers should not have to resort to—is introduced as soon as the engineer deviates from his established schedule of rates.

Bonus and Penalty System—The word "bonus" has fallen into such disrepute that the writer hesitates to use it, but knows of no other word. By bonus he means the premium earned for expert fulfillment of the con-

tract, as exemplified in some of the contracts of the Miami Conservancy District, or the North Jersey District Water Supply Commission (see *Engineering News-Record*, Nov. 4, 1920, p. 878). The writer would propose that the engineer enter into a contract to undertake the design and supervision on a percentage fee in accordance with the recognized schedules, but would at the same time agree that if, through his skill in office or field, the final cost of the work has been reduced from that first anticipated, he shall receive a bonus in recognition of his services in this regard. On the other hand, if his final designs result in a structure costing more than he had forecast in his first estimate, his fee would be proportionately decreased.

The bonus system might operate as follows: Suppose that the engineer's first estimate placed the cost of construction at $100,000 and he contracted to perform the services of design and supervision for 7 per cent. His fee would then be $7,000. By careful designing and the application of intricate original formulas such as are mentioned in the first paragraph of this article he is able to reduce the cost by $10,000. Then his bonus might be fixed at 7 per cent (or it might be placed at 14 per cent, or any other number) of the $10,000, or $700. On the other hand, if he did not take the necessary time in design to produce an economical structure, and the cost finally ran up to $10,000 in excess of the first estimate, he would be entitled to 7 per cent on the $100,000 but would be penalized 7 per cent of $10,000 or $700 on the excess cost. This bonus and penalty provision would tend to eliminate one of the great drawbacks of the percentage basis, discussed under A. The engineer would have a real incentive to get costs down to the practical minimum. Such a system will appeal to budget-makers as it will enable them to place a more definite value on engineering services than under any other system.

The objection might be raised that the engineer's bonus is figured from his estimate, and that he might put this high to play safe, and assure himself a bonus. The restraint on this procedure would lie in the fact that if the engineer did place an excessive estimate on the cost, the authorities would discard the project, and his own ends would be defeated.

Résumé—For purely consulting work—expert testimony, valuation, original investigations and reviewing drawings—a fee on the per diem basis should be most satisfactory to all concerned, especially when the contract stipulates the extent of the engagement. For the practising engineer, the modification of the percentage system by means of a bonus and penalty offers advantages over either the per diem or the flat rate. The bonus system inspires the engineer to produce the most economical structure consistent with the principles of good engineering.

It is true, however, that no system of fees will be satisfactory unless supplemented by a carefully-worded agreement between the engineer and the municipality, wherein the facts agreed to are set forth detailing the duties of the engineer and the items which shall be totaled in arriving at the basis of compensation. Such an understanding removes most of the objections to the bonus system, and together with it, should procure a working basis mutually satisfactory to the municipality and the practising engineer.

Water-Borne Typhoid at Ramsay, Mich.

THIRTY-SIX cases of typhoid fever occurring in the unincorporated village of Ramsay, Mich., early this year are attributed to the use of untreated, badly polluted river water. Ramsay is an unincorporated mining village of 1,800 persons, mostly foreigners who cannot readily speak English, located in Bessemer township, in the upper peninsula of Michigan. According to a short account of the epidemic by Dr. C. H. Benning, of the Michigan Department of Health, published in *Michigan Public Health*, April, 1924, "diarrhea has been extremely prevalent" in Ramsay for "several months" when in January a young man supposedly suffering from appendicitis was taken to a hospital in a neighboring town. The case was quickly diagnosed as typhoid. Thirty-five additional cases occurred in February and March. Dr. Benning and W. C. Hirn, assistant state sanitary engineer, were sent to Ramsay to take control measures. Within 36 hours an emergency chlorinating plant was installed and 12 hours later a temporary hospital with a capacity for 25 cases was in readiness. During the two weeks of state investigation and control 20 patients were admitted to the hospital, "thereby eliminating future contact cases." About 1,500 persons were inoculated against typhoid. Besides chlorinating the polluted water, a safe supply from the town of Wakefield was introduced in sections of the town previously supplied with the polluted water.

The nature of the water pollution that caused the outbreak is thus described by Dr. Benning:

> The houses are built on the sides of two hills facing each other, with a river running between them. Some of the houses have modern plumbing and the sewage from them enters the river. All the sewage from the school enters the Big Black River, 200 to 300 ft. above the location of the pumping station.
>
> The water supply of the town is varied: springs, wells, river water, and in one section of the town, piped spring water, which has been tested and found to be of good quality. The water supply of the school is piped from Wakefield, some four miles. The water there is under proper control and all tests up to the present have shown it to be of the best quality for drinking purposes. This in a large measure has prevented a widespread epidemic among the school children. The river water on every test has shown a high bacterial count.
>
> The two sections supplied with river water were the ones in which the typhoid occurred and to which it has been practically confined. This river water was piped in for fire protection by the mining company and at the request of the villagers connected with their houses for domestic use, but they were informed individually, by letter, that this water was unfit for drinking purposes. Unfortunately, as has been previously stated, a large proportion of the inhabitants are foreign born and with little or no knowledge of sanitation in even its crudest form. This warning was totally unheeded, as can be vouched for by the writer.

An English Terminal Hump Yard

Gravity switching for a freight terminal is an unusual arrangement adopted at the new East Side terminal of the Great Western Ry. at Bristol, England. The line from the hump serves fourteen parallel stub tracks, not by means of a ladder track but by several diverging tracks, each opening out into two or three of the body or stub tracks. A grade of 2 per cent leading up to the summit of the hump is followed by a descending grade of 3 per cent to the first set of switches and then 0.3 per cent to the parallel body tracks. For outbound movement, a double crossover enables cars to be moved on a surface track passing around the hump.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

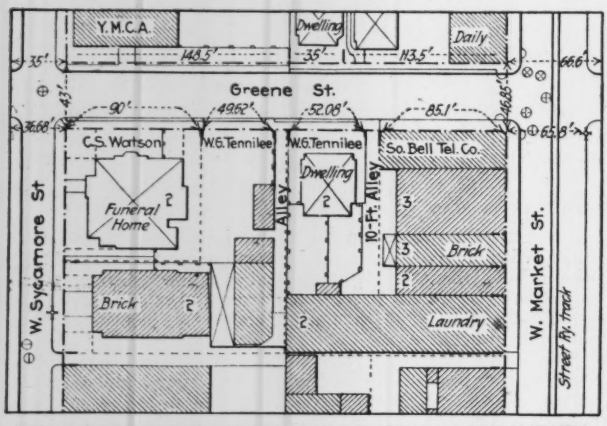
Some Notes on City Mapping

BY O. W. GATCHELL

Sanford, North Carolina

FOR MAPPING outline locations in congested city areas, a method using a field drawing board with direct plotting of all measurements as made with chaining equipment alone, without transit or plane table or notebook records, can, under certain conditions be used to good advantage.

Information usually required on city maps for tax and planning purposes comprises: (1) Legal locations, such as exact lot and block frontages, street widths



FIELD DETAILS PLOTTED FROM TAPE MEASUREMENTS

between and co-ordinates of occupied block corners; and (2) outline locations of all buildings, street works and sidewalks and locations of interior property line fences. From legal locations, evasion of street ordinances and property not listed for taxation can be uncovered. Outline locations are necessary for city plan purposes, condemnation proceedings and fire regulations.

The original preparation of such city maps involves triangulation, traverse, location of features and office reduction. Concerning primary horizontal control as developed from a triangulation network, practice is well established. Field methods for breaking up the city area for map control are also standardized, with local considerations determining size of map sheet and degree of accuracy required for transit and steel tape traverse. It is for the final step of mapping outline locations in congested city areas that a choice of several field and office methods becomes necessary, particularly because this phase of work will determine the cost and speed of release of the completed map, besides influencing the amount of detail shown.

Under certain conditions a hard copy of the map sheet, finished as far as mapping outline locations is concerned, can be made to final scale directly in the field, a block at a time, using a field drawing board mounted on a tripod, together with steel and metallic tapes for chaining equipment. Details are drawn directly on the field sheet, thus avoiding entirely a mass of notebook sketches and records which would later have to be worked up cold in the office. No transit, plane-table attachment or stadia is used by this method, measurements on the ground around the sides of the block being tied in on the work of the block traverse party with additional ties to curb lines where found straight. The locations for block interiors are then tied to these outlying locations by chained intersections.

For the city map in question, no contours were run due to local reasons. On a scale of 50 ft. to 1 in. some sixty sheets 28x40 in. in size composed the finished map covering 5 sq.mi. of area.

The accompanying figure shows the procedure for chaining-in the outline locations on typical area. The field party began work on a block with the field sheet for that block tacked on the drawing board. Beginning at a corner, measurements were taken down one side of the block for about half the length. All locations of street works, manholes, sidewalks and the like were run between the fronts of buildings and the center of the street. Outlines of fronting structures were mapped and to these the backlying locations of fences, outbuildings and alleys were tied. To show the firmness with which outline locations can be held by chained intersections, some actual measurements for intersecting important control points are given in the figure in dotted lines. From known points on the block traverse lines such as abutting building corners and lot markers, measurements were made to either side along the traverse to the intersection (produced) of the main outlines of fronting structures, after which their offsets were run. Short checks between outlines are readily apparent from the figure and were chained to keep a constant check on plotting.

Plotting went along with chaining, being carried forward from the block traverse and curb lines which had been inked on the field sheet. The chief of party remained at the board and plotted the measurements as called, placing the board so as to direct the two chainmen with fewest possible moves. An example of putting sight rod and chain to work that ordinarily would take a transit is shown by the tie line run down the 10-ft. alley where a right angle was turned with the chain off the marked traverse line. Chainmen then lined in as they measured out on the tie line to the various intersections (produced) of building and fence lines, thus checking the locations as chained direct.

Mapping of outline locations was preceded by the basic work of block and sheet traverse parties who worked by the usual transit and notebook methods. Legal locations thus obtained, such as exact frontages dimensioned in the figure, corner offsets and curb lines, were all inked in on the field sheet and used by the outline party as stated. Where block corners could not be occupied the block traverse was run in on the closest offset line giving clear observation. The map

sheet traverse bounded in normal cases an area three blocks square and thus controlled 15 to 20 block traverses. Only occasionally could a sheet traverse side serve as a side for one or more of the bounded block traverses, because of the necessity of securing a firm sheet figure. Allowable closure errors were 1:40,000 and 1:20,000 for sheet and block traverses, respectively. All traverse corners were referenced, certain sheet traverse corners being monumented for triangulation purposes. Different stages of work in mapping locations by the above methods were:

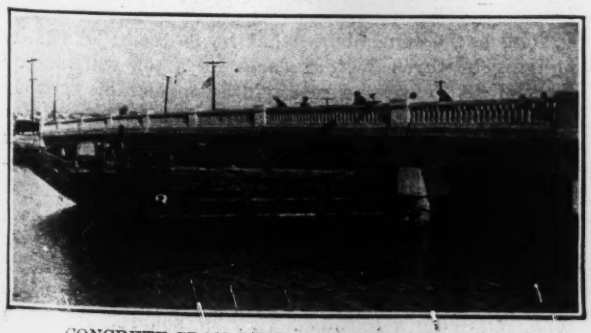
Place	Stage	Average Time
Field	Ran map sheet traverse	1 Week
Courthouse	Examined plots and corner lot deeds	
Field	Ran each block traverse	1 Day
Office	Plotted sheet and block traverses on master hard copy sheet, obtaining separate block field sheets therefrom by pricking through	After Field Hours
Field	Mapped outline locations on each block sheet	1 Day
Office	Adjusted lot frontages; on master tracing penciled traverses from master sheet, furnishing orientation for inking block sheet locations directly on tracing	1 Week

One map sheet covering 15 blocks (lap deducted) mapped and traced by engineer and 2 chainmen in 7 weeks.

Examination of this schedule shows that the office work, due to the direct field plotting method, consisted mainly of tracing. The methods described were developed by the writer while assistant engineer with F. T. Miller, consulting engineer, Greensboro, N. C. The writer would be glad to hear from others who have found similar methods useful for the direct plotting of city details. The method, in immediate conjunction with transit, should be found of value on transmission line and highway location for mapping right-of-way features, the general statement being that on survey work, where the use of a plane table is precluded, the mapping of those details for which scaled values are acceptable will go faster, be cheaper, and in the end more accurate, the more that direct field plotting replaces the customary notebook transcription of such details.

Tidal Power Lifts Concrete Bridge Span

ENGINEERS of the California State Highway Commission recently employed the ocean tide to assist them in removing a concrete bridge span 46 ft. long, weighing 168 tons, to permit a large dredge to enter the west channel of Alamitos Bay, in Los Angeles County. The bridge had been constructed with the possibility of its opening in view, and, when the city of Long Beach decided to do some dredging in connection with a new park project, permission was sought to open the bridge.



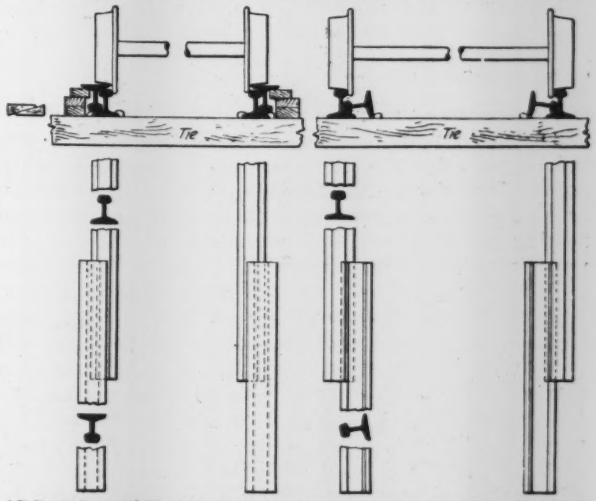
CONCRETE SPAN LIFTED BY TIDAL EFFORT

In lifting the bridge span, a barge 30 ft. x 104 ft. x 9 ft. deep with a draft of 2 ft. 6 in. was used. It was placed in position at low tide and 12x12-in. timber blocking was placed on the deck of the barge longitudinally to distribute the load and secure the necessary lift. Seven parallel lines of timbers were used, giving 49½ sq.ft. of bearing surface under the five girders, equivalent to a pressure of 3.4 tons per square foot on the blocking. The barge measurements showed a theoretical submergence of 21 in. due to the load of 168 tons. The actual lifting commenced at 23 in. submergence, the difference being required apparently to break the bond of the ¾-in. elastite expansion joint at each end of the span. Less than 10 min. was consumed in floating out the barge, no tugboat being required, and making fast alongside the bridge. As soon as the dredge had been taken through the bridge, the tug towing it returned, was made fast to the barge holding the span and towed it back to position. Exactly five hours after traffic was diverted from the bridge it was resumed.

The work was done by the United Dredging Co. under the direction of L. M. Ransom, assistant division engineer, at a cost of about $500.

Adjustable Rail Lengths for Track at Tunnel Heading

IN TUNNELS mucked by hand and hence where a slick sheet is used, the muck car can be run off the end of the track onto the slick sheet and thus brought as close to the muck pile as desired. Where mechanical equipment is used for mucking, however, slick sheets are not required and larger muck cars are employed thus making it impracticable or at least troublesome to get the cars closer to the face than the end of the track.



ARRANGEMENT OF EXTENSIBLE RAILS AT TRACK END

A means of overcoming this difficulty without the use of special short track sections and one which is extensively used in western tunnel work requires only two loose rails of standard length and section which are used as extensions to be slid out from the ends of the track. These additional rails are used either bottom up or lying on their side, as shown in the accompanying illustration. The side position is preferred because a considerable length of rail in this position may be laid on the tunnel floor without blocking or ties and is stable enough to carry safely cars of 6-cu.yd. capacity. In this side position the extensible rail becomes a groove or flange-bearing support for the wheel, the flange rest-

ing on the rail web and being kept from running off on either side by rail base and head, respectively. As the work advances the rail can be slid ahead until it has been extended for one full rail length, when the track can be brought up.

Some Remarks on Column Footings

By David C. Coyle
Gunvald Aus Co., Engineers, New York

THE METHOD of computing steel slabs for column bases dates back to the days before two-way floor slabs had demonstrated their remarkable strength and stiffness. Where there is no interference from the building law, I suggest the following method of computing these plates as more economical than the Carnegie formula and at the same time conservative. The Carnegie formula is rational for a rectangular plate with the column assumed as a uniform load on a rectangular area in the middle of the plate. According to this formula, $t = \sqrt{\frac{3W\ (A\ -\ a)}{64{,}000B}}$, in which A and a are the lengths of the slab and column rectangles, and B is the width of the slab. This formula is derived from the equation

$$M = \frac{W(A\ -\ a)}{8}$$

I propose to show that the uneven distribution of the load under an ordinary H column justifies the use of an equation $M = \frac{W(A\ -\ a)}{10}$

Consider as an example a 14-in. Bethlehem column of 228.5 lb. per foot, carrying a load of 870,000 lb. We will suppose that the allowable pressure on the concrete by the Joint Committee formula is 1,100 lb. per square inch, and that a convenient depth for the concrete footing gives a required perimeter of 120 in. for punching shear. We should then have a 28x32 plate with 970 lb. pressure. As this plate takes its load it will of course dish slightly, so that the pressure between the milled end of the column and the plate will vary from a minimum at the center of the column to a maximum at the tips of the flanges. Assume that the four outstanding legs of the column have a uniform pressure of 20,000 lb. per square inch on an area sufficient to carry the load, while the inner part of the column has no pressure. Such a condition would be quite safe, and it would occur, approximately, before the plate could fail.

In the sketch, one leg of the column is shown with the shaded area carrying 217,000 lb. at 20,000 lb. per square inch, the area being 11 sq.in. The bending moment in this plate is then

$$435{,}000 \times (7 - 4\tfrac{1}{2}) = 1{,}080{,}000 \text{ in.-lb.}$$

which is $\frac{1}{10.8}\ 870{,}000(28\ -\ 14.62)$, or $\frac{W(l\ -\ a)}{10.8}$

This moment has been figured with no regard to the two-way dishing action as it affects the strength of the slab; the method is the same as that used in deriving the Carnegie formula, except that uniform pressure is figured under the slab, but not under the column.

This example, in which the column has a unit-stress of 13,000 lb., represents the worst case, as columns usually go; often the unit-stress is less, seldom much more. It seems evident therefore that the thickness of the plate, instead of being figured from a bending moment of $\frac{1}{8}W(A\ -\ a)$, can be safely figured for $\frac{1}{10}W(A\ -\ a)$ in the direction of the flanges.

In the direction of the web the bending moment under the flange is very nearly that of a cantilever $8\frac{1}{4}$ in. long.

$$M = 870 \times \frac{8\frac{1}{4}}{34} \times \frac{8\frac{1}{4}}{2} = 925{,}000$$

which is $\frac{870 \times (32\ -\ 16)}{16}$ or $\frac{W(l\ -\ a)}{16}$

The bending moment per inch width is

$$\frac{1{,}080{,}000}{32} = 33{,}700 \text{ or } \frac{925{,}000}{28} = 33{,}000$$

The corresponding formulas for thickness of slab are, with steel at 16,000:

for bending around axis parallel to web:

$M = \frac{W\ (l\ -\ a)}{10}$, $t = \sqrt{\frac{W\ (A\ -\ a)}{26{,}700\ B}}$, A being less than B.

for bending around axis parallel to flanges:

$$M = \frac{W(B\ -\ b)^2}{8\ A},\ t = (B\ -\ b)\sqrt{\frac{W}{21{,}300\ AB}}$$

The plate used above as an example, if figured by the Carnegie formula, would be a square plate 30x30 in., and

$$t = \sqrt{\frac{870(30\ -\ 14.62)\ \times\ 3}{64.\ \times\ 30}} = 4.56 \text{ in.}$$

Figured by the proposed method we get

$$t = \sqrt{\frac{870(28\ -\ 14.62)}{29.3\ \times\ 32}} = 3.5 \text{ in.}$$

or

$$t = 16\ \sqrt{\frac{870}{21.3\ \times\ 28\ \times\ 32}} = 3.46 \text{ in.}$$

Figured by the "triangular" formula $\frac{W(A\ -\ a)}{12}$ we should get, for a 30x30 plate:

$$t = \sqrt{\frac{870(30\ -\ 14.62)}{32\ \times\ 30}} = 3.75 \text{ in.}$$

The conclusion is that one can safely make a plate 4 in. longer than its width, for 14-in. columns, and figure the thickness for the short dimension at $\frac{W}{10}\ (A\ -\ a)$, and similarly for other sizes of columns, so long as he remembers what he is about. A careful figuring of three or four cases on a job will indicate the method to use and result in a considerable economy of slab steel.

Footing Reinforcement—Another matter in which the standard practice is unsatisfactory is the computation of concrete footings for heavy pressures, such as occur on hardpan or rock. The smaller footings have to be so deep, in order to get the required bond in the steel, that it seems absurd to use any steel at all.

Consider a load of 200,000 lb. at a pressure of 10 tons, requiring a footing 3 ft. 2 in. square. Assume a 12x16-in. bearing plate. The bending is then, by the usual "triangular" formula,

$$\tfrac{1}{12} \times 200{,}000(38\ -\ 12) = 430{,}000 \text{ in.-lb.}$$

If $d = 24$ in., 1.3 sq.in. of steel are required. But for bond the case is not so good. We allow 100 lb.

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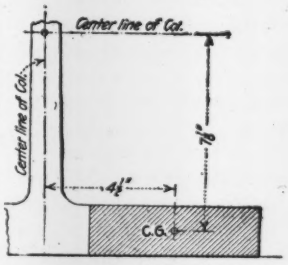
per sq.in. bond stress for deformed bars, plus 50 per cent for hooked ends, less 25 per cent because the bars are crossed, and use the formula $\Sigma_o = \frac{shear}{jdc}$

The shear $\frac{200 - 26}{4} = 44{,}000$ at one edge of the plate, and *jd* is 21 in., so that

$$\Sigma_o = \frac{44{,}000}{21 \times 150 \times \frac{3}{4}} = 18.5 \text{ in.}$$

total periphery of one band of bars. Thus, for the bond we should need ten ½-in. squars bars, which would be twice as much steel as required for bending. Three expedients are suggested for avoiding this anomaly.



ASSUMED BEARING OF COLUMN FLANGE

(1) Suppose that we use a footing 24 in. deep over all, and figure the friction on the rock as carrying the tension; 50 per cent is a conservative coefficient. Then consider the tension acting across a plane cutting through the center of the footing. As above noted we require 1.3 sq.in. of steel at 16,000 lb. per sq.in. or 21,000 lb. tension. Each half of the footing is therefore subjected to 21,000 lb. drag toward the center. At right angles to this section is another with a similar drag, making a resultant friction of $2 \times 21{,}000 \times \sqrt{2} = 60{,}000$ total for the whole footing.

At 50 per cent coefficient we should get a total friction for the whole footing of 100,000 lb., which is ample. The fact that stepped footings in brick were used for many years before the introduction of concrete, and that, though these footings had little if any tensile strength across the bottom, they seldom failed even on fairly soft soils, indicates that it is not unreasonable to depend on friction, *i.e.*, on a ring of sloping reactions on the rock or hardpan.

The required tension above noted was 1.3 sq.in. at 16,000 lb. or 21,000 lb.

(2) Suppose that we round the bottom of the footing so as to get a slope of 30 deg. at the edges. The friction would be negligible, and the pressure can be assumed to be nearly normal to the bottom surface, and all the lines of pressure would go through the bearing plate, so there would be no tension in the concrete at all. This extremely simple method, which would cost less for rock excavation and concrete and be easier to do in the field, has the fatal defect that it smacks of radicalism, and would inexpressibly shock any good conservative contractor or hundred per cent building inspector who might see it on a drawing. It will only serve where the contractor is intelligent and there is no building law.

(3) For small footings in clay or similar material, where the friction is uncertain, and vertical pressure only is desirable, the steel figured as necessary for bending can be inserted in the form of a square ring around the edge of the footing. No bond then need be figured, as the footing is a miniature dome with its tension ring. This method I believe was patented about thirty years ago, in which case it is free of royalty now.

As footings are designed under, for instance, the New York law, we have an unnecessarily high safety factor in the steel slabs, and we have in the concrete mat a set of rods with a high theoretical bond stress and an actual stress of probably zero in bond and tension. These points illustrate the fact that, where there is no rigid building law, it is possible to effect a considerable improvement in the design of footings without exceeding the conservative unit stresses.

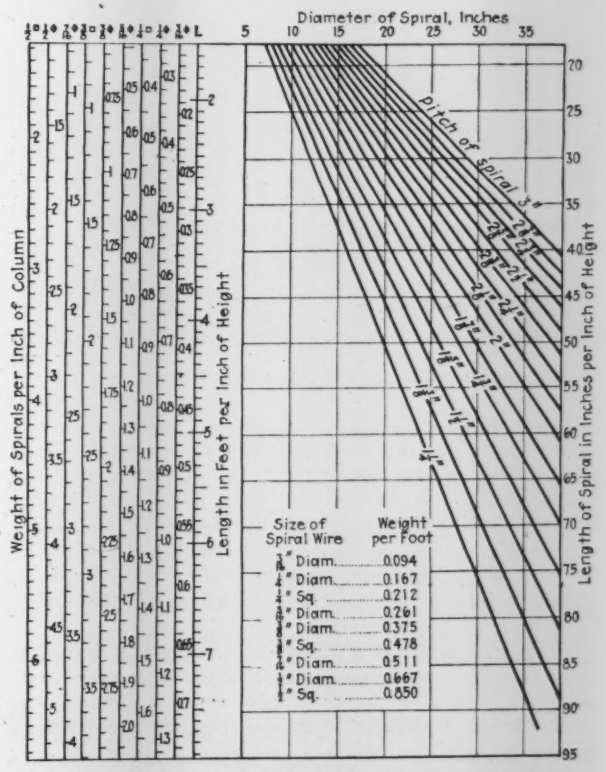
Chart Aids Estimate and Design of Spiral Concrete Columns

BY JACOB FELD

With Barney-Ahlers Construction Corporation, New York City

THE CHART shown herewith is an original one which I have found useful in estimating and designing spiral reinforced-concrete columns. It saves a considerable part of the work required in "taking off steel" and in determining the weight of spirals for ordering. Its use is as follows:

Starting with the diameter of the spiral or the


Diameter of Spiral, Inches
5 10 15 20 25 30 35
Weight of Spirals per Inch of Column
Length in Feet per Inch of Height
Length of Spiral in Inches per Inch of Height
Pitch of Spiral
Size of Spiral Wire
Weight per Foot
⅜" Diam. 0.094
¼" Diam. 0.167
¼" Sq. 0.212
⅜" Diam. 0.261
⅜" Diam. 0.375
⅜" Sq. 0.478
½" Diam. 0.511
½" Diam. 0.667
½" Sq. 0.850
CHART FOR DESIGNING SPIRAL CONCRETE COLUMNS

column core at the top of the sheet and following a vertical line down to the proper oblique line corresponding to the pitch of the spiral, the scale on the right gives the length of spiral in inches per inch height of column, and the first scale on the left gives the same in feet and decimals of a foot. The weight of the spiral per inch height of column is given for nine different sizes, including all the usual ones.

Movable Form for Circular Bins

By Nathan M. Kaplan
Contracting Engineer, Keeley Bros. Contracting Co., East St. Louis, Ill.

IN THE construction by the Illinois Glass Co., of Alton, Ill., of its Bridgeton, N. J., plant, an interesting feature was developed in building the sixteen circular reinforced-concrete bins forming the batch-handling plant. Each one of these bins has a diameter of 26 ft. and a height of 36 ft. with a wall thickness of 6 in. The bins are arranged eight to a unit, in two batteries of four bins each. Bins are fed from overhead conveyors, four of them emptying from a point near the bottom in the side of each bin, the other four emptying directly through a hole in the base. The latter four are dead storage and the first four live storage, and from them dry materials are taken, properly proportioned, and conveyed to the furnaces to be melted and made into glass.

In concreting these bins the usual sliding forms supported on green concrete were not used. The type used consisted of an inner and outer sectional form, circular in shape, about 8 ft. long and supported on each

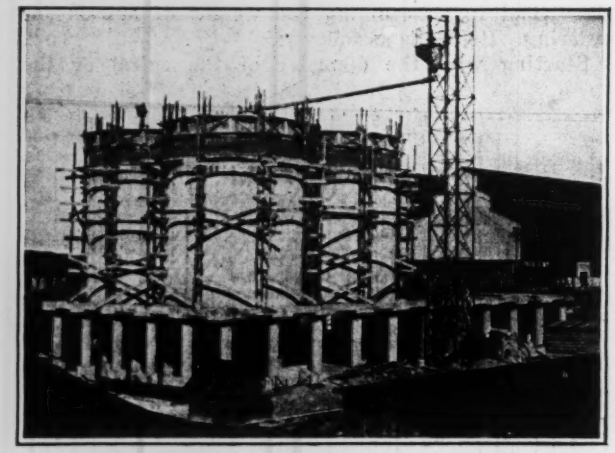


FIG. 1—MOVING FORMS SUPPORTED ON STILTS

end by a 4x4-in. stilt. The end of each panel was fastened to an iron rack, as shown herewith. Each section was about 4 ft. in height. Inasmuch as the racks actually supported the form and they in turn were carried on the stilts, all the weight of the forms was carried therefore by the stilts and not by any of the concrete. Four bins were poured in one operation, although the contractor found that all eight could easily have been handled together.

Work was accurately timed and not more than two rings poured every twenty-four hours. This speed naturally was obtained only in very warm weather. The limit during December was one ring in twenty-four hours.

As the forms were 4 ft. in height and as it took eight pours to pour eight bins, the concrete was given actually that much time in which to set to carry its own weight and stand the moving of the form.

At the time the first form was set on the base, the stilts, or 4x4s, were set two at each junction point, inside and out, about 6 in. apart. At the height of the top of the iron rack a notch was cut in each 4x4 and the ratchet jack inserted in these notches. To keep the form from spreading and to hold the stilt in position, a 2x4 batten was nailed to the 4x4 and a clamp fastened to it as shown. Since the clamps were placed only below the forms, no interference with the movement or concreting was offered. Men stationed at the jacks operated them all in unison, raising the form evenly.

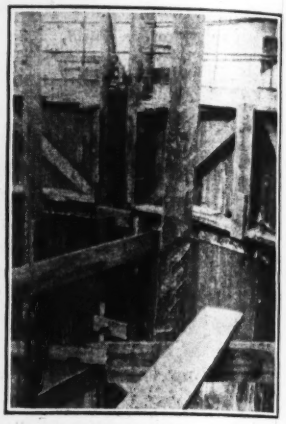


FIG. 2—FORM DETAILS FROM BIN INTERIOR

Continuous concreting is possible, but in that event the forms should be raised an inch or two, the steel placed and the form filled. As the weather did not permit the concrete to set sufficiently at the time the job was poured, a form was raised to total height, first on the inside, the steel placed, and then the outside form jacked up into position. When the form is raised its full height, the ratchet is taken out, new slots for it cut in the 4x4s and the operation repeated. The forms consisted of 2x12s cut to an arc on a band saw, and 1x4-in. sheathing nailed to it vertically.

The Bridgeton development of the Illinois Glass Co. replaced the old plant of the Cumberland Glass Co., whose property the former organization acquired. It was decided to do away with the old plant and house the new factory in a group of modern buildings, the construction herein comprising part of that development.

The bins were designed by the general contractors, Keeley Bros. Contracting Co., of East St. Louis, Ill., and the supporting structure was designed by the Illinois Glass Co.

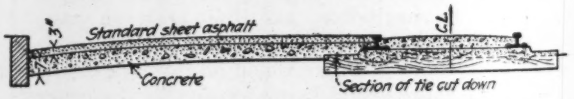
From Job and Office

Hints that Cut Cost and Time

Section for Surface-Car Concrete Street

By C. Perry Prann
City Engineer, Meriden, Conn.

DESIGN of a satisfactory pavement section consisting of a 3-in. asphalt top on a 7-in. concrete base in a street where a traction company maintains a single



RECESSED TIE GIVES ADDED PAVEMENT THICKNESS

track line was solved in Meriden, Conn., in the manner herein explained. In this particular instance the street car rail had a height of 5 in. and ordinarily the other specifications would permit of only 2 in. of concrete being placed on top of the ties.

The traction company had been asked to replace the 5-in. rails with 7- or 9-in. rails, but because the rails had been down only about three years, the traction company deemed it impossible to make replacements so soon. Therefore, resort to other means was necessary. After the grading was done and previous to placement of the

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pavement, a 2-in. cut was made at either end of the ties outside of the rails, 3 in. from the spikes. The upper 2-in. section, from the cuts to the ends, was then taken off with an adze. The concrete base and the area between the rails were then laid simultaneously and the sections from rail to curb later covered with standard sheet asphalt consisting of 1½ in. of binder and 1½ in. of wearing surface.

As is shown in the diagram, the cutting away of the sections at the ends of the ties gave additional space for the cencrete over the ties and, though it may have weakened the ties to some extent, this weakness was more than compensated for by the additional strength of the concrete base at these points.

Building 3,000 Ft. of Spring Wells Sewer in Record Time

HEAVY earth-handling equipment, steel forms, a mounted mixer fed by industrial cars from a material yard on a siding and day and night work enabled a contractor on the new Spring Wells (Mich.) concrete sewer to complete 3,000 ft. of 13½ x 18-ft. five-center arch

BASE FOR BELLMOUTH CONNECTION TO 13½ X 18-FT. SEWER

Small pump in sewer (at right) on sand bags discharged small seepage through hose into old brick sewer at lower left of picture. The building mixer shown in the photograph is not the paving mixer used on the straight-away run of sewer. It is fed in the same way, however, from dump cars running on a small section of the mounted elevated truck.

section from the middle of August, 1923, to the middle of November. The sewer was laid in a trench averaging 27 ft. in depth and has reinforcing in the bottom only. The thickness at the crown is 12 in., and at the base 18 in. The soil is of heavy, hard yellow clay underlaid with stiff blue clay containing little moisture.

Two ¾-yd. steam shovels, one working ahead of the other, dug a trench 50 ft. wide and 8 ft. deep. The surplus dirt was loaded on trucks on either bank and disposed of within a mile circle. For digging the remainder of the trench a dragline, mounted on skids and rollers, was equipped with a 75-ft. boom and 2½-yd. bucket which permitted disposing of the excavated material at a sufficient distance from the edge of the trench to eliminate the danger of slides. Back-filling was done with a steam dragline mounted on skids and rollers and equipped with a 2-yd. bucket.

Forms consisted of 120 ft. of telescopic steel forms with traveling conveyor for moving 30-ft. sections at a time; the forms were furnished on lease only. For outside forms sectional wood panels were made up of ⅞-in. matched lumber, 15 ft. in length fastened to 2 x 6-in. ribs cut to conform with the outside shape of the sewer. The forms were moved and set up by the night crew and were in place ready for the day crew to pour concrete continuously all day. Arch sections were poured in the morning while the dragline was excavating the bottom of the next section.

For concreting, a 1-yd. paving mixer was mounted on a self-propelled running gear. The track was made up of 80-lb. rails laid on the edge of the trench so that the mixer could discharge by chute directly into the forms. The mixer was charged by dump cars running on an elevated platform, 2 ft. high and 100 ft. long.

The material yard was located ½ mile away from the work alongside a 15-car siding. A 25-ton locomotive crane equipped with a 1½-yd. bucket unloaded the railroad cars and rehandled the material into a storage bin of 100-cu.yd. capacity. The bin was elevated to permit the industrial equipment to pass underneath. For transporting material to the mixer over the 24-in. gage track, two 4-ton locomotives and fifty 40-cu.ft. cars were used.

The work was carried out under the general direction of Clarence W. Hubbell, consulting engineer, by Raymond A. Mercier, contractor.

Job and Office Notes

In Order to Insure Steady Progress with the annual program for road construction, the Wisconsin State Highway Commission schedules the monthly progress desired, as follows: by June 1, 8 per cent; in June, 15; July, 25; August, 23; September, 20, and in October, 9 per cent. Thus 71 per cent of the work should be completed before September.

"Owing to the Fact That All the prepared expansion joints that I have used in concrete pavement allow the filler to be forced out forming a ridge on the pavement, I do not consider them a success, although they do take care of the expansion," writes Albert H. Tompkins, consulting engineer of Americus, Ga. "To eliminate these ridges I have tried different kinds of wood joints. As an experiment I placed blocks of wood in steel vises. The only one that expanded back to its original dimension was a cypress board.

"In January, 1923, I constructed a gage so that the expansion and contraction in concrete pavement could be measured, at the same time placing a ½-in. cypress board in a vise with a like gage; this vise and board were exposed to the weather the same as the concrete. The contraction and expansion of the concrete was checked twice a day and the vise was set to correspond. At the end of the sixty-second day the board was removed and within twenty-four hours it had expanded to its original ½ in. At the time that the board was removed it was compressed to less than ¼ in.

"At this time I was constructing a street parallel to one in which prepared joints were used and being confident that the cypress boards would give satisfaction I used them.

"I rode over this street a few days ago and did not experience the bumps caused by the ridges where prepared joints were used. I also found this street free of cracks, where another street constructed ten days before had developed several. Cypress decays very slowly but it is better to creosote the boards before placing."

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

To the Embryo Engineer

Sir—I have read with much interest your editorial entitled "To An Embryo Engineer," in your June 5 issue, and congratulate you particularly on that part of your editorial which reads as follows:

"What you have been studying is not overly important in itself; it will have value only as you apply it." And again: "You need not carry this modesty to the degree of humility, for the promised inheritance of the earth has as yet not been realized."

I have had great pleasure in talking to the embryo engineer, and have found that he is generally over modest, and has seemed to be gratified when I directed his attention to the fact that he is equipped to accomplish, and if he fails, he is to blame. I believe Henry Ward Beecher is credited with saying that if we did one half of what we are able to do, we would astonish the world.

Your editorial seems to be confined to suggestions on all strictly technical achievement. I should have been glad if you had gone further and impressed upon the embryo engineer the importance of his conduct toward his fellow men and the necessity of coupling a knowledge of affairs with knowledge of engineering. Probably all of these embryo engineers have read Hamlet, and are familiar with the precepts given by Polonius to his son. It may be, however, that these precepts do not continue in their memory, and I feel that at least certain of them should constantly be kept in mind, not only by engineers but all men. I refer particularly to the following:

"Give thy thoughts no tongue, nor any unproportioned thought his act. . . . Give every man thine ear, but few thy voice. Take each man's censure, but reserve thy judgment."

And most important of all: "This above all—to thine own-self be true, and it must follow, as the night the day, thou canst not then be false to any man."

CHARLES HANSEL,
Consulting Engineer.

New York City, June 20.

Costs and Rates of Painting Steel

Sir—In your issue of May 22, I note a letter from A. H. Sabin referring to my article on Sandblasting and Painting Steel Bridges, which was published in your issue of May 1. The criticism does not refer to the data on sandblasting but only to the data on painting given in Table I. Mr. Sabin says that the paint used was too cheap, that three coats should have been used, that the labor costs are too low, and that a man cannot put on as much paint as was shown in the table.

As to the paint used, Mr. Sabin quotes costs to prove it was of inferior grade. In this he assumes 1923 prices. The table referred to a portion of the work done in 1922, for which the paint was contracted in 1921 and delivered as needed. The table is arranged in such detail that price changes are easily taken care of by a simple substitution in the "material" column.

An additional factor is that the old paint was removed only where necessary, but it should have been added that where the steel was exposed it was "spotted" with red lead. This was charged under first coat. The steel was therefore given three coats where exposed and two over old paint which was not entirely removed.

The $1 for application is the correct figure to use, as I am making a comparison with my own figures, which were for application only.

Mr. Sabin considers our labor costs too low. Our painters were paid 62.5c. as stated. They are now getting 70c. The table showed that 65,000 sq.ft. were painted two coats for a labor cost of $1,174, or 1.8c. per square foot. Mr. Sabin submits some costs from a contractor which he considers very good. For two-coat work they give a labor cost of $1 for painting one ton. Assuming 200 sq.ft. to the ton, an average figure, we get from Mr. Sabin's data a labor cost of 0.5c. per square foot.

The table is so arranged, also, that any one can substitute his own labor rate. I have been commended by officials of the American Bridge Co., the Reading Ry., and others for my analysis of sandblasting costs.

Mr. Sabin objects that a man cannot put on 1.3 to 1.5 gallons per day without using a brush wider than 4½ in. or diluting the paint. Our painters are getting this result with a 3½ in. brush. On this point let us again analyze the contractor's costs which Mr. Sabin submits. For the cost of painting one ton he gives, paint $1.75, labor $1. His paint averaged $3.50 per gallon. We will assume labor at 70c. It follows that one ton required 0.5 gal. and 1.43 labor-hours, or a painter spread 2.8 gallons in one day. A higher labor rate would increase this. Was benzine used in the paint, or was it put on with a broom, or was the contractor not telling all he knew about costs in his business?

F. G. SCHWORM,
Assistant Engineer, Bureau of Highways of Philadelphia.

Philadelphia, June 1, 1924.

Lead Joints in Water-Pipe Plugs

Sir—I have read with interest the article on Testing of Holding Power of Lead Joints in Water Pipe Plugs, in your issue of May 15, p. 867.

It has been my practice to use a lead ring in place of oakum to seal the bottom of the bell, when placing plugs. This ring is made from small lead pipe flattened to size and driven in against the bead and then calked the same as the poured joint. The joint is then poured like other joints and calked again. This gives a joint in which the tendency to burst due to the wedging of the lead by the bear is removed from the extreme end of the fitting.

Although I have made an attempt to burst a fitting by heavy calking of the bottom lead ring, I have been unable to do so; but I know of many incidents where an ordinary poured joint has been burst by unskillful calking.

I conclude from the article that the pressure given at the time initial slipping takes place is approximately the pressure at which pipe without beads would pull apart unless restrained by other means.

S. P. BAIRD,
The Jennings-Lawrence Co.

Columbus, Ohio, June 16.

Land Drainage Decision in Wisconsin

Although the state of Wisconsin has failed to carry out its agreement to drain certain swamp lands, a recent decision of the State Supreme Court seems to support this neglect by nullifying the agreement, according to the following item in the quarterly report of the State Department of Engineering:

An important decision of the Supreme Court, in the case of Crawford County Levee and Drainage District No. 1, holds that the State Railroad Commission has not the constitutional authority to permit a drainage district to modify the flow in a navigable stream, or to improve its channel for drainage purposes even though the agricultural benefits would be great. The decision is based on the ordinance of 1787 which required the Northwest Territory to hold its navigable waters in trust for the people of all the states. This is thought to nullify the obligation which the state assumed when it accepted about 2,000,000 acres of swamp land from the federal government under the act of October, 1850, and promised to expend for drainage the money received from the sale of these lands. Since then the swamp land fund has been absorbed, but the lands have not been drained.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Freeman's Research Offers Are Extended

Mechanical Engineers and Boston Society Also Given Gifts of $25,000 Each

In addition to the $25,000 endowment given the American Society of Civil Engineers for research, particularly in the field of hydraulics, John R. Freeman, past-president of the society, has offered like sums each to the American Society of Mechanical Engineers and the Boston Society of Civil Engineers. The gifts are made, Mr. Freeman explains, "because of a lively and grateful remembrance of the encouragement" which association with members of all three societies inspired. Mr. Freeman had provided in his will the making available of these trust funds, but before leaving for Europe recently he decided to make the money immediately available.

In making his offer to the Am. Soc. C. E. Mr. Freeman wrote in a telegram delivered at the Pasadena meeting of the society to John H. Dunlap, secretary, that aside from scientific research, the fund might be diverted to the use of those willing to make translations of important engineering documents, or in the publication of professional papers and memoirs that, save for the provision of a few hundred dollars, might otherwise go unpublished.

Opportunities Offered

In clarifying his idea as to what the fund could accomplish Mr. Freeman says:

"I know of a case now, where an autobiography of one of our most inspiring scientists and educators is held back because no publisher has been found to take the risk. Again, a scientific memoir to which one of our most eminent American engineers had given many months was not finished at his death, lacking only some tabulations and a few insertions. It would have been forever lost had not his executors been prevailed upon to contribute a few hundred dollars for the employment of an extremely capable young engineer who willingly did what was necessary to prepare the manuscript for publication.

"Prof. Herbert Engels, long at the head of the hydraulic laboratory of the Technical High School at Dresden, has published in German a monumental work on water structures of which there is no English translation. The writer found that the publisher was ready to undertake this under promise of a very moderate share in underwriting the possible loss.

"For still another illustration—Brown University is custodian for the carefully selected library on river and harbor hydraulics and structures, accumulated by our past-president, Elmer E. Corthell. This has never been thoroughly examined, arranged or indexed. Doubtless some modest contribution extended over two or three summer vacation periods would induce competent engineering talent to go through this and dig out much that is valuable . . . , making information available . . . that would serve as a monument to Corthell, while instructing the student who does this work."

Mr. Freeman also expresses the hope that "others among the older engineers who have found in engineering 'joy in work' . . . will join a committee thus self-appointed" for building up a substantial fund for purposes of aiding principally the young engineer though the entire profession would benefit by it.

Engineers Given Honorary Degrees

Honorary degrees in engineering conferred by colleges and universities during the last two weeks included the following: A Doctor of Engineering degree, University of Michigan, conferred upon Orville Wright, pioneer inventor of heavier-than-air flying machines; Doctor of Engineering, Princeton University, upon Frank Calvin Roberts, an engineer of note on construction of high buildings, bridges, docks, power plants, water-works, steel works and rolling mills.

Rutgers College conferred upon George H. Blakeley, director and manager of the structural steel department of the Bethlehem Steel Bridge Corp., the degree of Doctor of Science. The University of Pennsylvania conferred the same degree, Doctor of Science, on Ambrose Swasey, noted engineer and manufacturer of Cleveland, Ohio, and the founder of Engineering Foundation.

Contractor Wins $902,896 Suit From City of New York

Damages aggregating $902,896 due the Litchfield Construction Co. from the City of New York were awarded recently by a jury in Justice Lydon's part of the Supreme Court, N. Y. The suit, which was brought to trial May 13, asked for $1,400,000 damages, which counsel for the construction company said had been caused by delay and alterations in the original contract for building sections of the Seventh Avenue, Brooklyn, subway.

Much extra construction was necessary and a great deal of extra time was consumed, the company charged, in complying with the varying demands of the city authorities. During the trial a huge model of the section of the subway from Fifty-first Street to Fifty-ninth Street in Brooklyn stood in the court room. It was referred to frequently during the month's trial.

Barge Canal Improvement Estimated at $25,200,000

High Figure Represents Widening and Deepening Channel To Make Available Two Lake Routes

An estimate made public by Dwight B. La Du, New York State engineer, shows that the probable cost of the project of widening and deepening the Barge Canal connecting the Hudson River with Lake Erie at Buffalo and including a connection with Lake Ontario from Three Rivers on Oneida River near Syracuse to Oswego would cost approximately $25,200,000, which would make available two routes to the Great Lakes. To enlarge the canal from Oswego to the Hudson, making but one route to the Great Lakes available, would cost about $8,500,000.

The original design and construction of the Barge Canal contemplated a future enlargement if the necessity arose. The structures in the land sections of the Barge Canal in the western part of the state are located in such a manner that no extensive changes of bridges would be required to increase the width of the canal to 110 ft. while the eastern portion of the canal is located principally in lakes and rivers where the minimum width is 200 ft.

Evidence of the necessity for this improvement is the newly constructed motor ships now operating between Duluth and New York via the Barge Canal. These ships have a width of 38 ft. and it is difficult for them to navigate and pass each other in the 75-ft. land sections of the canal. It is proposed to excavate these sections to such a width that no difficulty will be encountered. No work can of course be undertaken without legislative authorization and appropriation.

Mr. La Du is also preparing estimates to show the cost of an American canal to connect Lake Erie with Lake Ontario. Such a canal would leave Lake Erie at Buffalo and follow a semi-circular route to the Niagara River below the Falls at Lewiston. Mr. La Du points out that such a route would provide both navigation and power development possibilities.

Maddock Out For Governor

Thomas Maddock, state highway engineer of Arizona from 1919 to 1922, is a candidate for the Republican nomination for governor of that state. Mr. Maddock won a wide reputation as a road builder, the period of his administration being an era of extensive highway construction in Arizona. His administration was subject to violent political attacks after his retirement, but these failed to undermine his professional standing and popularity among his lay friends.

St. Lawrence Commission Inspects River

The full personnel of the United States St. Lawrence Commission, headed by Secretary of Commerce Herbert Hoover, made an inspection of the St. Lawrence River from June 13 to 17. The commission, together with its engineering advisors, assembled at Niagara Falls, N. Y., inspected the power developments, and moved over to the other side of the river where it made similar inspection of the developments of the Ontario Hydro-Electric Power Commission and the construction under way on the new Welland Canal. It then went across to Toronto, visited the harbor work there, and passed on down the river in a two-day trip, terminating at Montreal. Some members of Canada's National Advisory Committee on the St. Lawrence Waterways Project met the American committee informally, but there was no joint session of the two committees. The engineers of both committees, however, were together for most of the trip and made informal examinations of the various sites for structures along the route.

The American commission consists of Herbert Hoover, chairman; W. C. Breed, New York; James P. Goodrich, Winchester, Ind.; James E. Davidson, Bay City, Mich.; Charles L. Allen, Worcester, Mass.; James R. Howard, Chicago; James D. Noonan, St. Louis; Stephen B. Davis of the Department of Commerce, counsel; and Charles P. Craig of Duluth, executive secretary. The engineers consist of Brig. Gen. Edgar Jadwin, Col. William Kelly, and Lieut. Col. G. P. Pillsbury, all of the Corps of Engineers. Col. Pillsbury was not present on the trip because of assignment to another important service at that time. The engineers of the Canadian commission are D. W. McLachlan, asst. chief engineer, Dominion Department of Railways and Canals; O. O. Lefebvre, chief engineer of the Quebec Streams Commission, and Brig. Gen. C. H. Mitchell of Toronto, consulting engineer. Paul Clapp, of the Department of Commerce, is Mr. Hoover's engineering representative.

St. Louis Studies Rapid Transit

A subway or some other system of rapid transit for St. Louis, Mo., is to be considered by a special committee of seven members of the St. Louis Board of Aldermen. This committee will determine on ways and means of conducting a survey to ascertain the city's transportation problems with an idea of correcting them with rapid transit. The Civitan Club has asked the city to appropriate $20,000 for such a survey. Tentative plans for an underground loop in the central business district calls for an expenditure of $25,000,000. This is the first definite step taken by the city administration toward obtaining rapid transit for the city.

SECRETARY HOOVER INSPECTS THE WELLAND CANAL WORK

From left to right: Secretary Hoover, Alex. Grant, chief engineer of the Welland canal work, Mr. Allen and Governor Goodrich, of the U. S. St. Lawrence Commission.

THE ENGINEER ADVISORS TO THE ST. LAWRENCE COMMISSIONS

From left to right, Mr. Lefebvre, Mr. McLachlan and Gen. Mitchell of the Canadian Staff and Gen. Jadwin and Col. Kelly, of the American staff. Col. Pillsbury was not present on the trip down the St. Lawrence, being detained on other Corps duty.

Taylor Assumes Corps Direction

Direction of the Corps of Engineers of the War Department was placed in the hands of Major General Harry Taylor at noon June 18. Major General Lansing H. Beach, the retiring Chief of Engineers, has made no plans for the future. By way of vacation, he will spend the summer in California. While past the retirement age, Gen. Beach enjoys the best of health and may be expected to participate actively in engineering matters.

Miles Cannon Out; Kreutzer Succeeds Him

George C. Kreutzer, of California, has been appointed director of farm economics for the Reclamation Service. He succeeds Miles Cannon, as a result of the civil service examination. Mr. Kreutzer received the highest rating among a number of candidates for the place. He has been serving as superintendent of the Durham project in California.

Reports from the West are to the effect that there is to be a change also in the Bureau's director of finance. D. W. Davis was assigned to that position on being superseded as Commissioner of Reclamation by Dr. Elwood Mead. It is stated that he will retire from the Bureau of Reclamation to accept a place with the Bureau of Internal Revenue in the Treasury Department.

Further Study of Flood Prevention at Cumberland Advised

Following the unusual floods on the Potomac River in March and May of this year, an engineering committee of seven members was created by the city authorities of Cumberland, Md., to advise the city on flood control measures. This committee held a conference in Cumberland on May 15 and since then has formulated a brief report with recommendations for further study. The commission advises that the city employ a consulting engineer to make field surveys, preliminary plans and estimates for flood control at Cumberland, and to suggest methods of meeting the cost of the work. The committee also suggests that two consulting engineers in addition be appointed to co-operate with the engineer who makes the detailed studies in the formulation of a report.

The engineering commission consisted of the following: G. H. Friend, representing H. R. Pratt, chief engineer, Western Maryland R.R.; H. A. Lane, chief engineer, Baltimore & Ohio R.R.; Earl Stimson, chief engineer, maintenance, Baltimore & Ohio R.R.; L. T. Downey, representing J. N. Mackall, Maryland Roads Commission; R. L. Rizer, city engineer, Cumberland, Md.; E. S. Tisdale, chief engineer, West Virginia State Board of Health; Abel Wolman, chairman, chief engineer, Maryland State Department of Health. This commission is to continue as an advisory and steering body for this work, by request of the authorities of the city of Cumberland.

Boston Water-Supply To Be Investigated Again

Three Commissioners to be Appointed Soon Will Consider Possible Reduction of Water Consumption

Three commissioners are to be appointed by the governor of Massachusetts, in accordance with an act passed at the recent session of the legislature, "to study further the water-supply needs of the metropolitan district and other communities which may require water from the metropolitan system, and of the city of Worcester." One of the commissioners is to be a citizen of Boston, one a citizen of Worcester, and one a citizen of Hampden, Franklin or Hampshire County — counties from which it has been proposed to develop an additional water supply from the Ware and Swift Rivers. Salaries of $6,000 a year for the chairman and $5,000 a year for the other two members are authorized by the act.

The commission is directed to consider possible reduction of water consumption in the metropolitan district "through further prevention of waste or otherwise"; the possibility of "utilizing to a greater extent the watershed tributary to the Wachusett reservoir." The commission is also directed to review "the findings and recommendations" of the joint board that reported on the metropolitan water supply in 1922" (see *Engineering News-Record*, March 2, 1922, p. 360) to study the Ware and Swift River projects, and "other feasible sources of water supply, including water purified by filtration"; to consider how soon the metropolitan district and other municipalities referred to in the act need to be provided with additional water, and in what quantity, and in what order in point of initial and subsequent developments; and finally "to determine the best method of increasing the water supply of the city of Worcester." Subsidiary to the main investigations of the commission will be the determination of the best method of apportioning the cost of an additional water supply among the various municipalities benefited. The act directs the State Department of Health and the Metropolitan District Commission to supply the new commission "with all information in their possession" which it may require for the purposes of the proposed investigation.

May Employ Consultant

The commission is given authority to "employ as consultant a disinterested engineer of acknowledged professional standing, qualified as an expert on water-supply matters," together with other engineering and clerical help. Subject to appropriation by the legislature, the commission is authorized to expend in its studies $100,000, on approval by the governor and council, but of this not over $30,000 is to be available during the current fiscal year. The money already mentioned is to be provided by the state, but is to be collected from the metropolitan water district and the city of Worcester in proportions to be determined by the commission.

Finally, the report of the commission and of its consulting engineer, together with plans and estimates, must be submitted not later than Dec. 1, 1925. The life of the commission will terminate with the filing of the report.

Reclamation Project Authorized on a New Basis

In the last days of the just concluded session of Congress, both the Senate and House passed a bill authorizing construction of the San Carlos irrigation project in Arizona. During consideration of this bill emphasis was placed on the new form of arrangement under which this project is to be constructed, and on the merit of the undertaking. Representative Snyder, of New York, characterized it as the first businesslike irrigation project ever brought into the House. Representative Cramton, of Michigan, among other things, said: "The time has come when we must refuse to appropriate for reclamation projects except on a strictly business basis. In this case, for the first time since I have been following reclamation projects, a bill has been presented on such a basis. This bill provides for the payment of interest upon the money expended by the Government in the work of construction. It provides for the payment of operation and maintenance charges in advance, as is the case on private projects. It is located in a region where they make a success of irrigation by reason of climatic and other conditions."

Collapse of Building Caused by Old Floor Alteration

Early in June an old three-story brick building with timber floors, on 7th and League Sts., Philadelphia, collapsed, under rather unusual circumstances. The second floor failed by the breaking of a main joist, due partly to overloading and partly to the weakening effect of alterations made a long time ago. The breaking of the floor joists kicked out the side wall, so that the entire building was wrecked.

The building was 60 or 70 years old, and originally had floor framing of 3x7-in. joists (on a span of about 16 ft.) regularly spaced. Many years ago, apparently about fifty years, the central portion of the second floor had been cut out, on a width of about 8 ft., for a length of five or six joist spaces, and 3x7 trimmer beams had been put in to carry the ends of the original joists and intermediate lengths of joists. The header beams into which the trimmers framed were not strengthened by doubling, and the floor thus was greatly weakened. In recent years the building was used as a store, and the second floor was piled full of potato sacks and produce. The beams sagged under this continued loading, until finally one of the header joists broke. The alterations in the floor were made long before the city bureau of building inspection functioned. The facts were brought out by the investigation of the accident made by the bureau after the collapse.

California Utilities Face Serious Power Shortage

Unprecedented Dry Year and Increase In Load Force Edison System To Cut Usage 25 P.C.

Special Correspondence

Due to an unprecedented dry year and a tremendous increase in load California electric utilities are faced with the most serious situation in their history. The Southern California Edison Co., on account of the extent of the territory it serves, has found it physically impossible to meet the demands for power and has ordered a 25 per cent curtailment of power usage over its entire system effective June 16. This order comes as a result of a conference between executives and engineers of all southern California electric utilities and representatives of the state railroad commission.

Testimony at the hearing brought out the fact that there would be a shortage of 126,000,000 kw.-hr. on the Edison system during the last six months of the year which would require a curtailment of approximately 20 per cent. Other utilities represented at the hearing showed that they would be able to meet the demands for power on their own systems and in the case of several of the companies they would be able to sell power to the Edison company to help relieve the situation.

A unanimous request was made by the utilities represented for the appointment of a power administrator to assist in an equitable distribution of the power available. The name of J. G. Butler, former chief of the division of water rights of the state department of public works, who acted as power administrator during the shortage of 1920, has been suggested for the position. Unnecessary employment of energy for flood lighting, display lighting, etc., will be discontinued first. Industrial consumers will be asked to reduce their energy consumption.

Lindenthal to Examine Plans for Portland Bridges

Multnomah County, Ore., has retained Gustav Lindenthal, of New York, as consulting engineer to examine the plans for the Burnside, Ross Island, and Sellwood bridges, which are involved in the recent indictment of former county commissioners, engineers and contractors for bribery in connection with the engineering retainers and the construction contracts for these bridges. Notice of these actions appeared in the issues of May 15, p. 873, June 12, p. 1036 and June 19 p. 1074. The new county commissioners, in a public statement, say that the case relating to the engineering work involves two phases, "the possibility of corruption at the time the contract was made and that of engineering relative to the adequacy, efficiency and integrity of the structures planned by the engineers." The first is a question for the court, and the second is to be determined by the present investigation. It is said that doubt has arisen in the minds of many of the citizens as to the ability of the engineers to carry out successfully the commission given them.

General Contract System Upheld by Federal Government

The general contract system of doing public work construction is vindicated and the theory that greatest economy is promoted through the separate contract system under which individual agreements would be made between owners and those handling distinct installations such as plumbing, heating equipment, electrical fixtures and wiring, etc., has been rejected by the Interdepartmental Board of Contracts and Adjustments of the federal government. This agency is one created by General Dawes when he was head of the Bureau of the Budget. The bureau has adopted a resolution which has the effect of refusing to abolish the general contract system from federal construction operation. The resolution was adopted by the board in answer to a request for adoption of the separate contract procedure made by a joint committee of the National Association of Master Plumbers, the Heating and Piping Contractors National Association, and the Association of Electragists International. Selection of the form of contract to be executed is therefore left with officials making them.

The claims made by this committee in favor of the separate contract system were replied to in a brief filed with the Board by the Associated General Contractors in America, it being through this brief that a case for the general contract system was established.

In coming to its decision the board laid particular emphasis on the fact that should the separate contract system obtain it would "take away from the government any advantage which it might otherwise secure from the utilization of the general contractors organization" and it would "tend to delay performance and give rise to claims for delays of one contractor by another and create difficulties which are largely avoided when the work is performed under one contract."

Northern New York Utilities to Develop Two Sites

The Northern New York Utilities, Inc., Watertown, has made application to the New York Public Service Commission for authority to develop power at the Soft Maple site on Beaver River and the Sewall's Island site on the Black River at Watertown. The estimated cost of the Soft Maple development is $2,370,000 and of the Sewall's Island development $340,000.

At the Soft Maple site an earth-fill diversion dam, about 65 ft. high, will be built. The main dam will also be an earth-fill dam and will be about 120 ft. high. About 20,000 hp. will be developed in two units operating at a minimum head of 117 ft. Provision will be made for an additional unit as a future extension.

The Sewall's Island project will develop the fall in the south channel of Black River in Watertown, where a concrete flume about 445 ft. long will lead to a power house containing two units each with a capacity of 1,250 hp.

Hoover Traffic Committees Organized for Study

Study of the extent to which traffic laws and rules, speed limits, signal systems for police and drivers, pedestrian facilities, one-way streets, illumination, road marking, and similar factors influencing highway safety was begun last week by a special committee invited by Secretary of Commerce Hoover to undertake this survey and analysis as a part of a movement initiated to improve street and highway safety. In this movement a number of national organizations are co-operating with Secretary Hoover.

The findings of this committee, headed by Major Roy F. Britton, president of the Automobile Club of Missouri, and the conclusions which they reach will be presented as part of a widespread program before a conference in the fall to which all organizations engaged in promotion of greater safety will be invited. From this coming conference it is hoped that steps may be taken to reduce the growing toll of deaths and accidents on streets and highways, and to develop greater uniformity of action on the part of the various states, both through state and municipal governmental and non-governmental organizations.

Reforestation Bill Praised by Lumber Company

What is called by the lumbering industry the most forward step in practical forestry yet made is the McNary-Clarke reforestation bill passed by the Senate just prior to adjournment. The bill had previously passed the house. In effect, the bill proposes appropriation of susbtantial amounts for co-operation by the federal government with the states and timber land owners in the protection of forest lands from fire; in the reform of present systems of forest taxation; in the popularizing of reforestation by specific aids to the establishment of farm wood lots; and in practical timber conservation by enlarged research and experimentation.

The sum of $2,500,000 is made available for federal aid, for fire prevention and suppression, and for the study of forest perpetuation and the taxation of forest lands. Sums of $100,000 each are provided for the procurement, production and distribution of forest trees and plants for the purpose of establishing wind breaks, shelter belts and farm wood lots upon denuded or non-forested lands and for assisting owners of farms in establishing, improving and renewing wood lots, shelter belts, wind breaks, and other valuable forest growth, and in growing and renewing useful timber crops.

Extension of national forest areas is provided by authorization given the Secretary of Agriculture to purchase such cut-over or denuded lands within watersheds of navigable streams as may be necessary to the regulation of the flow of such streams, and in authorization given the President to set aside, within boundaries of government reservations other than national parks, reservations considered valuable for the production of timber.

Random Lines

Now, Who's an Engineer?

Sir—Perhaps we, who would arrogate to ourselves the right to use the title "engineer," had better look to see if our claim can be substantiated.

We like to feel that, because we are technical men, we alone are properly described by the term "engineer," with such modifications as we, and we only, think appropriate as, for instance, civil, mechanical, electrical, sanitary, and a few others.

And so, in "Random Lines," each week the editor of *Engineering News-Record* takes a poke at all those other upstarts who dare to style themselves "clothes-pressing engineers," "shoe-shining engineers," or "what-not engineers."

Yet, like the rest of us, this same editor is a technical man and, if asked to define a term and prove the authority for his definition, would undoubtedly refer to the dictionary, than which there can be no higher authority.

And here's what my dictionary, a 1924 model of Webster's New International, says:

"*Engineer* (n) — One who carries through an enterprise by skillful or artful contrivance; an efficient manager.

"*Engineer* (v.t.)—To use contrivance and effort for; to guide the course of; to manage; as, to *engineer* a bill through Congress.

"*Engineering* (n) — Maneuvering; contriving."

If I remember correctly, I have heard of a Tony, the bootblack, who was such an efficient manager that he amassed a million dollars. Some engineer, even if he never claimed the title.

Political engineering is suggested by the second definition above. While few of them might be able to show diplomas, there must be a sufficient number of men who are qualified by experience or achievements right now to organize the Am. Soc. P. E.

And, if you knew some plumbers as well as I do, you'd have to admit that their work was well within the limits of the third definition.

You might withhold the "sanitary" but you couldn't help calling it engineering.

Oh for a name that we can copyright and keep to ourselves! C. F. D.

The dictionary, of course, does not make the language; it merely records usage. And the fact that *Engineering News-Record* has been able to collect over one hundred examples of this distasteful usage testifies to the reliability of the dictionary makers.

* * *

Following the Dictionary

Crime Engineer Is Sentenced—Los Angeles, June 16.—Pleading guilty to a charge of engineering the $200,000 Providence Loan Company robbery here some months ago, Ivy McCarty was today sentenced to San Quentin for from one year to life.—From the San Francisco *Journal*.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

The Seattle Chapter, Associated General Contractors of America, recently elected the following officers: president, G. J. Keiburtz; vice-president, J. S. Christie; secretary, George Teufel; treasurer, Alfred Carlson.

A Dallas, Texas, Chapter of the Associated General Contractors has been organized by the general contractors of that city. The officers are: president, L. W. Hickey; vice-presidents, Owen Hughes and W. H. Maclay; secretary, H. H. Crane; treasurer, Arch Munn.

Western Washington Society will be the new name of the present Seattle Section of the American Society of Civil Engineers, provided that approval is obtained from the Board of Direction of the association. The local membership at its April meeting voted in favor of the change.

Personal Notes

MAJOR CHARLES A. BROWNE, formerly state highway engineer of Florida, has been engaged as county engineer of De Soto County, Florida, and will devote one day per week to the work, keeping a registered engineer on the job the rest of the time; the construction program involves the expenditure of $500,000.

MAJOR WALLACE W. KIRBY, Corps of Engineers, has returned to duty as director of the Bureau of Engraving and Printing, for a six-months' period; he had previously served in that capacity but was removed under a ruling of the Controller General that army officers could not serve in civilian capacities without special authorization of Congress, and the reinstatement is made under provisions of a congressional resolution approved May 31, 1924.

FRED G. SIMMONS has been made manager of the Contractors' Association of Northern California, with headquarters in San Francisco, succeeding Herbert Nunn, who resigned recently. Mr. Simmons, who was state engineer of Oklahoma during 1923, began his professional career in 1889 in the employ of the Denver Tramway Co. in charge of tracks and paving. For fifteen years he was engineer of way and structures for the Milwaukee Electric Railway & Light Co. and in 1912 was appointed commissioner of public works in Milwaukee. A later period of five years was given to private practice as consulting engineer. Mr. Simmons is a past president of the American Electric Railway Association.

U. F. BROWN, for the past twenty-eight years city clerk of Yreka, California, has been appointed city manager of that city. The office was created under an ordinance recently passed by the city trustees.

L. W. MOORE, for the past year city engineer of Lompoc, California, has been appointed city engineer of San Luis Obispo, California, and will have charge of an extensive street paving program.

H. F. STIMM, civil engineer, has opened offices in Ellicott Square, Buffalo, to engage in the design, construction and maintenance of railroad sidings and industrial tracks.

RAY S. GODDARD, for fourteen years construction engineer for the Illinois Glass Co. on work at its various plants, has resigned, effective July 1, and will take up a new line of work in September.

T. C. SHULER, recently resident engineer for the Wichita County, Texas, Water Improvement District 1, has become assistant engineer on dam construction, presumably at the Trinity River reservoir, for the City of Dallas Water-Works Improvement District.

GEORGE E. CATLIN, JR., until recently located at Champaign, Ill., in the service of the Illinois Department of Public Works and Buildings, has removed to Peoria, Ill., to work as junior engineer in the Illinois Division of Highways.

JOHN G. STUPP who was for some time chief engineer of the St. Louis Structural Steel Co., St. Louis, Mo., has accepted the position of chief draftsman for the Blaw-Knox Co.

C. H. WINDHAM, city manager of Long Beach, Calif., has acceded to demands of citizens and city council and withdrawn his resignation which was to have become effective July 1; he has also refused a salary increase. He had planned to enter the services of a Southern California steamship company.

CHARLES E. GRUNSKY, San Francisco consulting engineer, and president of the Am. Soc. C. E., has resigned as engineer in charge of the Gordon Valley water project, for the city of Vallejo.

ALEXANDER GRAY, chief engineer of the Canadian Public Works Department at the St. John, N. B., branch office, has returned from a tour of English, Irish, Welsh and Scotch ports, where he studied port conditions and dock construction with a view to using new methods in dock construction in Canada. H. F. BENNETT, an assistant engineer to Mr. Gray, has been transferred to the Halifax branch of the Canadian Public Works Department.

F. G. GOODSPEED, another assistant in the St. John branch, has been transferred to the headquarters in Ottawa. Both are now at their new posts.

W. M. BOSWORTH, Tacoma, Wash., has been appointed city engineer of Tacoma, to succeed C. E. Putnam, resigned. Mr. Bosworth was connected with the city engineer's office.

J. W. PRICE, for four years building inspector at Anaheim, California, has been appointed city manager of that city, succeeding O. E. Steward, resigned. The building and engineering departments of the city will be combined under one head, operating under the city engineer. E. P. Hapgood is city engineer, recently appointed, due to the resignation of Clyde D. Butler.

L. F. GATES, city engineer of Huntington Beach, California, has resigned and plans to enter the service of the federal government.

Obituary

GUIEN VICTOR BARRIL, an engineer of the Canal Zone, who went to Panama with the Canal Commission in 1904, died recently at his home in Balboa Heights, after a short illness. He was born in New York City in 1879 and graduated from St. Francis Xavier College there. He was one of the pioneer engineers of the Panama Canal, and at one time was chief engineer of the Panama Construction Co., then building a 50-km. section of the Panama national highways. He also was engineer on construction work on a Brazilian railway.

MAX A. SCHUMACHER, secretary-treasurer of the John A. Schumacher Co., general contractors, Indianapolis, Ind., died recently at his home in that city from pneumonia, aged 50 years. The company has constructed many of the largest buildings in Indianapolis.

ALBERT CARR, for many years consulting engineer of the Interborough Rapid Transit Co. of New York City, died June 19 at his home in East Orange, N. J., in his 65th year. Mr. Carr built about 75 miles of underground electric lines for the Metropolitan Street Railway Co., New York, surveyed and designed the Brooklyn and Union Elevated Railroads, built the Columbus Ave. cable road, part of the Lenox Avenue subway, and supervised subway construction from City Hall to Grand Central for the Rapid Transit Commission. An extended biographhy will appear in a later issue.

E. C. TOLLINGER, U. S. assistant engineer in the Third Mississippi River Commission District, died June 18 at Vicksburgh, Miss., aged 79 years. He was a native of Pennsylvania and, after Civil War service and some railroad work; entered the federal engineers' service in 1879 on work on the Tennessee River at Chattanooga, whence he was transferred in 1882 to Mississippi River work. He was active in levee construction in the lower Yazoo and upper Tensas districts.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Machines at Work in Open-Air Road Show

Latin-American Delegates See American Construction Equipment in Operation at Greensboro, N. C.

ONE hundred or more manufacturers of road-building machinery and materials participated in the Open-Air Road Building and Maintenance Demonstration held at Greensboro, N. C., June 3-7, under the auspices of the American Road Builders' Association for the benefit of the visiting delegation of 37 prominent Latin-American engineers and highway officials constituting the Pan-American Highway Commission, now touring this country. The show, which was managed by Charles M. Upham, state highway engineer of North Carolina, was staged on the local fair grounds and differed from former indoor exhibits in that the equipment could be shown in actual operation. This applied to such machines as power shovels, concrete mixers, trench excavators, road graders, tractors and trucks. In addition to demonstrations of machines at the fair grounds, other equipment was inspected on work under contract for the North Carolina Highway Commission, represented by Frank Page, chairman, who conducted the party of distinguished visitors to points of engineering interest throughout the state.

Preliminary announcements that short sections of roads of various types would be constructed during the exhibition, just as if the work were a contractor's job, were hardly borne out. However, enough of the motions were gone through to indicate clearly what the methods were and to permit an easy visualization of those that were omitted. Many of the exhibits of accessories, such as culverts, were arranged to simulate actual conditions of installation.

Tractors Haul Graders—Several types of graders and scrapers, attached as trailers behind different models of tractors, were hauled back and forth and made to move the earth as if engaged in highway maintenance. One exhibit in particular reproduced closely construction operations and included the formation of side ditches by means of a back-sloper attachment on the grader. Approximately 100 yd. of earth road were built during the four days.

Another exhibit which, from the educational standpoint, could do justice to itself only by practical demonstration, was a ditcher combined with a conveyor for discharging at one side of the trench the earth deposited on it by the excavating buckets.

Machinery at Open-Air Road Show in North Carolina

Power shovels with various sizes of dipper were in more or less continuous operation. One was engaged in loading a truck with dumping body which carried the earth a short distance before discharging it and returning for another load. A shovel mounted on crawler treads was the center of an admiring group.

The subgrade and the equipment for forming it received attention in the exhibit of another manufacturer. In order to show its product to advantage, this manufacturer staked in position a few lengths of steel side forms upon which were mounted and operated a machine for finishing the subgrade to specified shape. In addition, there were displayed on the forms a finishing machine operated by gasoline engine and a hand-operated machine for belting the concrete surface to final smoothness.

Many concrete mixers were installed and revolved under power.

Gravel Plant—Gravel screening and storage plants were operated on real materials, thus enabling the observer to appreciate the several steps involved from crusher to final separation in the bins. One model in miniature of an entire stationary plant included the crusher and all other pertinent accessories and was operated with small pebbles.

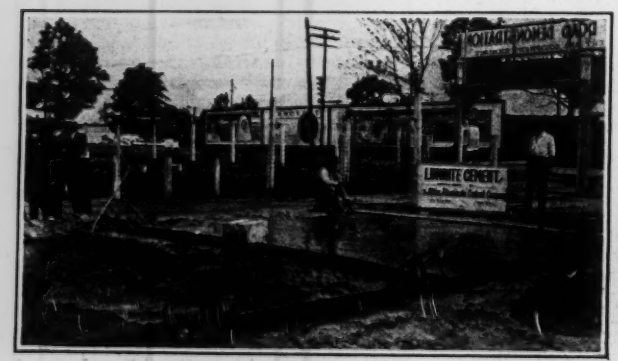
Compressors were operated to deliver air to drills which worked on large blocks of stone. Their application and the application of other air-driven tools was fully demonstrated.

Build Concrete Road—One of the more spectacular demonstrations of the show was the building of a 50-ft. length of concrete road 18 ft. wide at the entrance to the Greensboro fair grounds. A feature of this construction was the use of high alumina cement, named Lumnite, which has the property of attaining hardness in a remarkably short time. The pavement construction was finished at 2 p.m., Wednesday, June 4, and the first traffic passed over it at 9:30 a.m. Thursday, 19½ hr. afterward. The vehicles included a 10-ton caterpillar tractor, a 15-ton oil tank truck, and a 16-ton water flusher, none of which damaged the slab.

In the line of auxiliary equipment or accessories there were several types of culvert made of corrugated iron, concrete and hollow tile.

Bituminous surfacing equipment was represented by a large and complete asphalt plant.

The Pan-American Highway Commis-



Demonstration Section of Concrete Road, Built of Quick Hardening Cement, Carries Traffic 19½ Hours After Completion, at Greensboro (N. C.) Road Show

sion, with its 37 delegates, represents 19 of the 20 republics of Latin America. This commission devoted the first of its four weeks of road inspection and analysis in the United States to a study of conditions in North Carolina. The visitors displayed particular interest in a compact, lightweight equipment developed by the North Carolina State Highway Commission for making test borings at proposed bridge sites.

Exhibitors at Open-Air Road Show, Greensboro, N. C., June 3-7, 1924

Acme Road Mchy. Co.
Adams & Co., J. D.
American Casting Co.
American Gas Accumulator Co.
American Tar Prod. Co.
Asheboro Wheelb'w. Co.
Ingersoll-Rand Co.
International Motor Co.
Indiana Truck Corp.
Manufacturers Record.
Marchant Calculating Co.
McMyler - Interstate Co.
Newport Culvert Co.

Latin-American Delegates See Tractor-Hauled Grader

Asphalt Association.
Asphalt Pavement Retreading Co.
Atlas Lumnite Cemt. Co.
Austin - Western Rd. Mch'y. Co.
Autocar Sales Co.
Barber-Greene Co.
Black & Decker Co.
Blaw-Knox Co.
Buda Co.
Buhl Company
Bureau Public Roads.
Carolina Steel & Iron Co.
Carey Co., Philip- Lockland.
Celite Products Co.
Cleveland Tractor Co.
Contr's. and Eng'rs' Monthly.
Corbitt Motor Truck Co.
Craven, E. F.:
Lakewood Eng'g Co.
Best Tractors, Inc.
Watson Wagon Co.
Dillon Supply Co.
Dixie Metal Culvert Co.
Earnest Bros.
East Iron & Machine Co.
Etnyre & Co., E. D.
General Equipment Co.
General Motors Tr'k.
General Utilities Co.
Gilbert Mfg. Co.
Gerlinger Electric Steel Casting Co.
Godwin, W. S., Co.
Gray Concrete Co.
Greene, S. J.
Gurley, W. & L. E., Co.
Hall-Warford Co.
Haiss Mfg. Co., Geo.
Heltzel Steel Form & Iron Co.
Hibbard - Tree Pub. Co.
Hinkley Motors, Inc.
Hvass & Co., Chas.
Highway Maintainer Co.
Noble Motor Truck Corp.
North Carolina Highway Commission (Bridge Dept.).
North Carolina State College of Ag. & Eng'g.
North State Culvert & Machinery Co.:
Good Roads Mchy. Co.
Monarch Tractors.
Avery Co.
Ransome Concrete Machinery Co.
Novo Engine Co.
Sidney Steel Scraper Co.
Burch Plow Works.
Eagle Wagon Works.
Wiard Plow Co.
Raleigh F. W. D. Sales Co.
Republic Motor Tr. Co.
Russell Grader Co.
Schramm, Inc.
S. E. T. Valve & Hyd. Co.
Superior Boiler Wks.
Texas Co., The.
Tractor & Machinery Sales Co.:
Holt Mfg. Co.
Stockland Road Mchy. Co.
Pawling & Harnischfeger Co.
Sauerman Bros.
Smith Eng'g. Co.
Universal Motor Co.:
Hadfield - Penfield Steel Co.
Full-Crawler Co.
A. C. Johnson Prod. Co.
Gustav Schaefer Wagon Co.
Wehr Co.
Warren Bros. Co.
Western Display & Mfg. Co.
Wheeling Corrugating Co.
Wilkins, J. D.
White Co.

Standardization to Establish Basis for Pan-American Trade

At a conference of representatives of United States manufacturers interested in Latin-American trade, held in Boston, June 3, under the auspices of the American Engineering Standards Committee, resolutions were passed designed to extend in Pan-American engineering and industrial fields the general principles of standardization and thereby establish a sound basis for better and more intelligent trade. This action precedes a conference on Pan-American standardization to be held in Lima, Peru, next November and called by the Pan-American Union. Either the Inter-American High Commission or the Pan-American Union will serve as the official channel of communication in this field without the creation of any new international machinery. The resolutions at the Boston conference were drawn up by a committee headed by Charles E. Skinner, of the Westinghouse Electric & Manufacturing Co.

Business Notes

HARVEY T. GRACELY, advertising manager, Marion Steam Shovel Co., has been promoted to assistant sales manager.

CLARENCE E. SILVA, formerly in the engineering department of the Marion Steam Shovel Co., has been promoted to the position of advertising manager made vacant by the advancement of Harvey T. Gracely to the assistant sales managership of the company.

T. R. HARRISON has assumed charge of the research department of the Brown Instrument Co., Philadelphia. He was formerly associated with the pyrometry department of the Bureau of Standards and more recently with the Champion Porcelain Co., Detroit.

UNIVERSAL ROAD MACHINERY Co., Kingston, N. Y., manufacturer of stone crushers, elevators and screens, has appointed as its representative for the Northwest the J. J. Ross Mill Furnishing Co., Seattle, Wash.

LENHER ENGINEERING Co., New York, for 20 years sales agent for the S. Flory Manufacturing Co., has been appointed Eastern sales agent for the Bay City Foundry & Machne Co., Bay City, Mich., manufacturer of power-driven winches, capstans and cranes for motor trucks, as well as deck auxiliaries and the Dreadnaught vertical capstan and car puller. The company will continue its distribution of the Flory hoisting engines and other products.

JOHN A. ROEBLING'S SONS Co., Trenton, N. J., manufacturer of wire rope, gave a private exhibition last week of its 5-reel moving picture entitled "Heat X—The Story of Wire Rope." All operations from delivery of raw materials to shipment of finished product were shown, emphasis being placed on the careful selection of materials and frequent testing during the process of manufacture. The film was planned and produced for the Roebling company by the Pathescope Co. of America, Inc., New York.

JOHN J. ENNIS, Cincinnati, Ohio, has been appointed distributor for the Novo Engine Co., Lansing, Mich.

THE PITTSBURGH TESTING LABORATORY announces the occupancy of its new laboratories and office building at Stevenson and Locust Sts., where it will have greatly improved facilities for service.

EDWARD VALVE & MANUFACTURING Co., East Chicago, Ind., announces the appointment on May 1 of the Dunbar Engineering Co. as its New York representative, with offices at 50 Church St.

W. C. MCDOWELL has been elected a director and vice-president in charge of sales of the Traylor Engineering & Manufacturing Co., Allentown, Pa.

TEXAS CREOSOTING Co., Orange, Tex., a new organization, began last month operating on full time. The products of the plant are creosoted piles, poles, ties, timbers, crossarms, and sheetpiles, particularly the Martinez interlocked type. The company has adopted the use of a copper monogrammed dating nail as a means of identifying its product.

KNICKERBOCKER PORTLAND CEMENT Co. has established offices in the City Savings Bank Building, Albany, N. Y.

L. A. MARSHALL, for a number of years service manager of the Industrial Works, Bay City, Mich., has been assigned to the company's Chicago office as sales engineer.

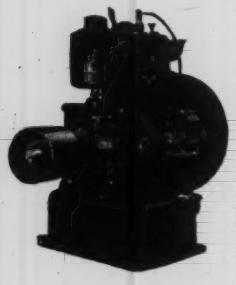
WILSON WELDER & METALS Co. announces the removal of its plant and general offices from New York to the Wilson building, Hoboken Factory Terminal, Hoboken, N. J.

HERBERT J. DESSON, manager of the Detroit office of the Blaw-Knox Co., died, after a brief illness, April 16 at the age of 44 years. Mr. Desson was born in Cleveland and joined the company in 1916; three years later he was placed in charge of the company's Detroit branch. His successor, just appointed, is Irving A. Pfeil, of the company's Chicago office. Mr. Pfeil is a civil engineering graduate of Ohio Northern University. During the World War he served as lieutenant in the air service. He has been with the company since 1919.

Equipment and Materials

Small Gasoline Power Unit

A complete power plant unit, requiring no accessories or attachments other than four holding down bolts, is being manufactured by the Collis Co., Clinton, Iowa, in the form of a vertical single-cylinder, 4-cycle engine, built in two sizes, 3 and 5 hp. In the design of the unit portability, light weight, compactness and high power delivery were the main considerations. A feature of the equipment is the incorporation of the radiator on the inside of the flywheel. This method of cooling requires only 5 quarts of water, which is circulated through the cylinder and radiator by a direct-driven centrifugal pump. Strong air currents reach each honeycomb radiator tube by vanes in the flywheel, an increase in the speed of the engine sending more air through the radiator. This plan of cooling eliminates fans, belts, and pulleys. The engine is equipped with gear-driven high tension magneto and an impulse starter coupling.

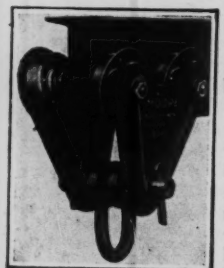


The engine base serves as the fuel tank from which gasoline is pumped to a Zenith carburetor built on the Venturi tube principle. As an option a gravity-feed system with tank attached to the side of the cylinder can be furnished.

The engine speed is controlled by a hand lever. A graduated scale quadrant shows the speed of the engine and the horsepower developed. The engine may be throttled down to 600 r.p.m. or advanced to 1,000 r.p.m., the rated horsepower being delivered at 950 r.p.m. The bearings, of white metal, are fitted with laminated shims between halves, making it possible to take up any wear without replacing parts.

Ball-Bearing I-Beam Trolley

A new ball-bearing, oscillating type of I-beam trolley has been announced by the Chisholm-Moore Manufacturing Co., Cleveland. It is called the "Moore" and identified by bright red frames which are made of steel. The wheels have the bearings built in, making one unit. The trolley weighs only 17½ lb. complete and has only eight parts exclusive of washers, cotter pins and nuts. It is built in one size only, to handle loads up to 1 ton inclusive. It is adaptable to any size I-beam of from 4 to 7 in. and by the substitution of special separators, at slight extra cost, can be used with larger beams. The trolley can be used with any makes of chain blocks and hoists for the overhead handling of material.

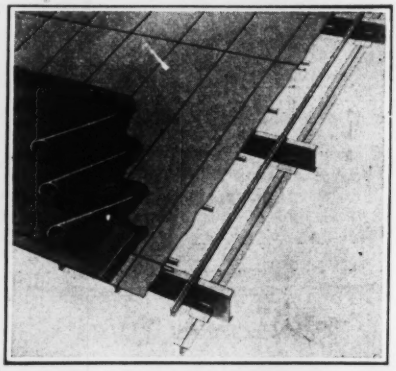


Tests of Gypsum Sheets

In reporting the results of tests of Gyp-Lap, an exterior sheathing of gypsum encased in tough fibre, the deflection of a frame sheathed with this new product of the U. S. Gypsum Co. was incorrectly stated in the June 5 issue of this journal, p. 996, to have been 1¼ in. at a pull of 90 lb.; the deflection noted occurred at a pull of 900 lb.

New Roof Has Flat Deck of Copper Steel Units

A new form of lightweight, fireproof steel deck construction, making possible flat roofs with slope of ¼ in 12 in., is announced by the Truscon Steel Co., Youngstown, Ohio. The deck is of copper steel with stiffening angles welded to the plates to add strength and rigidity. Eaves, gables, ridges and gutters are reinforced. On the flat steel surface built-up roofing materials



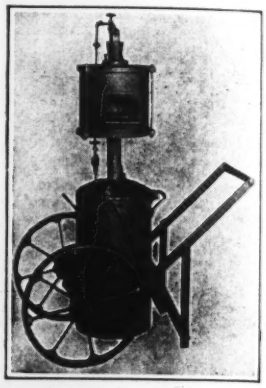
are cemented with roofing pitch. The result is a non-combustible roof, designed for a 40-lb. live load, but which has been tested to 160 lb. without failure; the roof weighs 4½ lb. per square foot. The underside is easily painted and forms an ideal reflector of light.

The roof is standardized and factory built in units. Expansion and contraction are automatically taken care of at the joints, which occur every 2 ft., preventing cracking, sagging, twisting or warping. The roofing is built up on the job as soon as the steel deck is in place and is cemented with a positive bond, with no open laps or joints.

Improved Features of Oil-Burning Rivet Forge

Two changes have been made in the oil-burning rivet forges, designated Nos. 1 and 2, manufactured by the Buffalo Forge Co., Buffalo, N. Y. These consist of an extension of the fireproof liner through the fire opening in the steel shell and a redesigned bottom plate made with a liberal shelf extension to receive hot rivets.

The forge consists essentially of a welded steel oil tank on which is mounted a head or fire chamber. This head is made up of a circular steel plate housing held between cast-iron top and bottom plates by means of three bolts. The lining of the fire chamber is a one-piece, removable, circular section of firebrick 2 in. thick at the sides and 2½ in. thick at the bottom, made of the best quality refractory material. An old lining is easily removed and replaced when necessary. The oil tank is tested under a pressure of

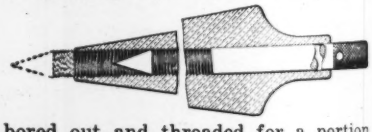


125 lb. which is ample insurance against leakage. Air is supplied by means of a single connection which furnishes pressure for the oil supply, as well as for the atomizer. Kerosene, distillate or any fuel oil is burned in this forge with equal ease.

This unit, weighing 125 and 200 lb. in two sizes noted, can be readily made into a portable forge for use in factories or on construction work by mounting on a special small size two-wheel truck.

New Two-Piece Plumb Bob Has Protective Feature for Point

A new design of plumb bob, built in two parts, a brass body and a steel spindle, has been developed by Henry O. Brooks, civil engineer, 16 Shattuck St., Lowell, Mass. The special feature of the device is the means provided for protecting the point of the plumb bob and renewing it at small expense in case of damage. As shown in the accompanying cross section the body is



bored out and threaded for a portion of the distance to receive a steel spindle pointed at one end. When in use the spindle is screwed down so that the point projects; at other times, by screwing the spindle in the reverse direction, its point retires to a position of safety inside the brass body of the bob where it cannot be damaged. Another advantage of the disappearing point is that the bob may be carried in the pocket or tool bag without puncturing a hole in the fabric. If the point should accidentally be damaged, a new spindle can be fitted into the body without the expense of purchasing a new plumb bob.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Commercal Building Awards Increase

Number and Value For First Five Months Greater Than Year Ago—New York City Leads Other Sections

Building contracts awarded throughout the United States during the first five months of this year, at a minimum value of $150,000 and not including industrial construction, numbered 1,187, as against 1,021 for the corresponding period in 1923. The average value per contract was $374,000 for the first five months of this year, compared with $390,000 from January to June, last year.

So far as buildings are concerned, it is evident that this year is ahead of 1923 in actual number of jobs, but falls short of last year in average value per contract.

The part played by New York City in the nation's building program is brought out in the accompanying tabulation of contracts according to classification, number and value.

Awards listed in this table do not cover mills, factories, machine shops or other industrial buildings; they do, however, include offices, stores, warehouses, garages and other commercial structures.

The total value of large building contracts for the first five months of 1924 was $443,448,000, 22 per cent of which was awarded in New York City. At least 39 per cent of the lettings for hotels and apartments; 37 per cent of the exchanges and 22 per cent of the schools and offices were in New York City. Only one per cent of the stores and 2 per cent of the clubs, lodges and halls, however, were awarded in this city.

(*Continued on p. 1122*)

Business Briefs

..**Call money** easy at 2 per cent, June 23.

Time loans for short periods at 2½ @ 3 per cent; longer credits, 3¼@3½ per cent.

Commercial paper, all names, rated at 4@4¼ per cent.

Foreign exchange (Demand):

	Normal	This Wk.	Last Wk.	Year Ago
Sterling...	$4.86⅛	$4.32⅞	$4.32⅛	$4.61⅛
Franc....	0.193	0.054⅛	0.0552⅛	0.0617⅛
Lira.....	0.193	0.0432⅛	0.0433⅛	0.0444⅛

CLASSIFICATION OF BUILDING CONTRACTS ACCORDING TO USE—NUMBER AND VALUE FOR FIRST FIVE MONTHS OF 1924

	Jan. Thousand	Feb. Thousand	Mar. Thousand	Apr. Thousand	May Thousand	Total Thousand	Per Cent of Total	N. Y. City Total Thousand	N. Y. City Per Cent of Total
Hotels and apartments	$19,405	*$36,971	$28,428	$15,756	$38,870	$139,430	37.60	$54,095	39
Schools	12,728	16,259	16,059	19,707	18,067	82,820	18.70	18,051	22
Offices	19,785	16,654	11,145	8,800	9,876	65,760	14.80	14,300	22
Hospitals	3,215	16,537	3,230	11,439	12,282	32,703	7.40	1,700	5
Stores	6,905	4,680	1,850	4,912	6,813	25,160	5.60	350	1
Warehouses	†3,033	†3,210	3,619	1,627	5,632	17,121	3.84	1,050	6
Theaters	450	1,585	2,300	2,675	9,000	16,010	3.62	2,900	18
Churches	2,479	3,217	3,402	1,752	4,000	14,850	3.30	950	6
Clubs, lodges and halls	1,862	1,581	3,294	3,713	3,585	14,935	3.00	150	2
Public	3,810	654	3,797	1,679	2,725	12,665	2.80	.....	..
Garages	†3,580	†3,375	1,550	610	1,395	10,510	2.41	.....	..
Banks	2,427	1,079	1,860	1,633	1,310	8,309	2.00	1,050	13
Exchanges	1,335	.....	1,000	575	1,165	4,075	1.00	1,500	37
Total	$81,014	$105,802	$81,534	$74,378	$114,720	$443,448	100.00	$96,096	22

	Jan.	Feb.	Mar.	Apr.	May	Total (1924)	Total[1] (1923)
Number	266	229	218	225	249	1,187	1,021
Average contracts	$359	$458	$374	$330	$458	$374	$390

* Includes $18,000,000 project
† Minimum $40,000, thereafter $150,000.

Bids Wanted on Big Jobs

See Construction News, pp. 371 to 383, regarding the following:

Power plant, Copco, Calif., California-Oregon Power Co., Klamath Falls, Ore., $4,000,000.

(*Continued on p. 1122*)

Bids Received Below Engineers' Estimates

A list of several contracts awarded during the past three weeks in which the bids received were considerably below the engineers' estimate in each case, is shown in the accompanying table.

These jobs are scattered throughout the country and cover the following classifications of work: water-works, sewers, bridges, dams, streets, roads and drainage ditches.

The reason given for the appearance of so many bids so far below the engineer's estimate, is that construction is falling off in certain sections of the country and contractors in these localities are scaling profits down in order to hold their organizations together. Local fluctuations in sand and gravel prices have evidently not been taken into consideration by the engineers and in addition to that, the sudden curtailment in various manufacturing industries has thrown an unusual amount of cheaper common labor upon the market during the past few weeks.

BIDS RECEIVED BELOW ENGINEERS' ESTIMATES ON VARIOUS JOBS THROUGHOUT THE COUNTRY

Location	Nature of Job	Engineer's Estimate	Bids Received
Ill., Vandalia	Concrete paving	$44,168	$38,163
			40,790
			41,415
Ill., Astoria	Sewer: 2,650 lin.ft. 10-in. and 24,900 lin.ft. 8-in.; 74 manholes; 9 drop manholes; 2 auto flush tanks; 3 non flush tanks, etc.	41,235	33,574
			33,928
			37,820
Okla., Oklahoma City	Installing 26 flood gates in dam and extension of same	200,000	198,000
Ind., Kosciusko County	Road: 5.66 mi., 18 ft., hard surface paving	100,957	85,900
Ohio, Hamilton County	Road: 14,690 ft., 16 ft. wide; 25,000 cu.yd. grading; 200 cu.yd. concrete; 1,512 lin.ft. 12-in. to 48-in. corr. pipe; 3,100 cu.yd. crushed stone; 1,600 cu.yd. screenings, etc.	68,640	60,524
Ind., Dearborn County	Concrete arch bridge	75,000	69,933
			77,000
			77,800
Ind., Jefferson County	Road, grading and gravel	30,159	26,775
			27,302
			27,559
Ind., Hamilton County	Road	58,414	49,474
			52,491
			54,968
Ind., Wayne	Concrete paving	96,764	85,222
			85,788
			88,500
Okla., Oklahoma City	Enlarging drainage ditch, grading and bank protection; 300,000 cu.yd. excavation	80,000	74,132
			76,364
			77,428
Ohio, Toledo	Water lines	42,278	38,904
		26,490	23,405
		18,391	17,092
		17,084	16,075
		20,732	18,388
		6,703	5,948
Ore., Harrisburgh	Bridge, concrete and steel; three 180-ft. spans	225,000	183,200
			186,400
			186,825
			183,200
N. J., Newark	Street: 2,000 sq.yd. grading and paving with 3-in. sheet asphalt on 6-in. concrete	79,000	72,243
Mo., St. Louis	Sewer: section, reinforced-concrete horseshoe, 14x11 ft.x2½ in.	208,000	174,769
Mo. St. Louis	Sewer: section, reinforced-concrete	305,000	301,860

Commercial Building Awards Increase

(*Concluded from p. 1121*)

Despite reports of slowing down in building construction in other sections of the country, New York City continues to expand her building program.

A recent survey conducted by S. W. Straus and Co. shows that plans filed in the five boroughs of this city in May amounted to $65,377,437, a gain of 64 per cent over the corresponding period in 1923. May permits were of larger volume than for the same month of any previous year.

NUMBER OF BUILDING CONTRACTS LET FOR VARIOUS TYPES IN FIRST FIVE MONTHS OF 1924

	Jan.	Feb.	Mar.	Apr.	May	Total	Aver. M
Hotels & Apts.	85	51	71	56	56	319	$437
Schools	40	51	51	64	67	273	303
Offices	22	20	20	17	20	99	665
Hospitals	12	12	8	19	14	65	503
Stores	14	16	10	16	16	72	353
Warehouses	22	13	8	3	15	61	280
Theatres	3	3	4	7	5	22	728
Churches	15	15	15	10	17	72	203
Club	6	5	9	13	14	47	299
Public	12	2	6	5	9	34	372
Garages	19	36	6	4	6	71	148
Banks	11	5	8	8	6	38	276
Exchanges	5	..	2	3	4	14	290
Total	266	229	218	225	249	1,187	$374

Bids Wanted on Big Jobs

(*Concluded from p. 1121*)

Club, Philadelphia, Pa., Penn Athletic Club, $3,000,000.

Auditorium, Los Angeles, Calif., $1,250,000.

Drainage, Shrewsbury, La., $1,250,000.

High School, San Francisco, Calif., $818,000.

Bridge, Evansville, Ind., to exceed $1,000,000.

Sanitarium, Ft. Worth, Tex., $1,000,000.

Sewer, Tulsa, Okla., $450,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 5, the next, on July 3.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	—$3.44	$3.80	—$4.20	$3.30	$3.45	—$4.10	$3.60	$3.60	$4.20
Structural rivets, 100 lb.	4.00	4.35	4.90	3.75	3.90	5.15	5.00	4.25	5.00
Reinforcing bars, ¾ in. up, 100 lb.	—3.34	3.30	3.38	3.20	3.35	3.85	3.65	3.50	2.70
Steel pipe, black, 2½ to 6 in. lap, discount	44%	55%	43%	47%	55.05%	36%	36.80@49.10%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	—60.60@61.60	45.50	—59.00	57.20@60.20	58.50	68.00	59.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	—1.80
Gravel, ¾ in., cu.yd.	1.75	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—58.00	40.00	—57.20	51.50	38.75	—31.00	36.00	—23.00	—60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.40	2.70	2.10	2.80	10.50
Common brick, delivered, 1,000	23.65	12.00	14.10	11.00	13.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.091	.11	.064	.08	.075	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.091	.11	.....	.....	.075	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	1.03	1.14	.94	1.08	1.18	1.05	1.13	1.01
Common Labor:									
Common labor, union, hour	.75	.30	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.70). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Conditions Affecting the Market

All price changes in the nine cities reporting weekly to *Engineering News-Record* were in a downward direction for the week ended June 26.

The declines occurred mainly in steel shapes, cast-iron pipe and lumber. Structural shapes dropped 10c. per 100 lb. in Denver, 15c. in New York and 20c. in Dallas warehouses during the week. Cast-iron pipe declined $1 per ton in New York and $2.50 in Dallas. The price of yellow pine timbers fell $2 per M. ft. in New York and $3 in Dallas, while Douglas fir declined $2 in Seattle and $6.75 per M ft. in Denver.

Lumber production, for the entire country, increased over 5,500,000 ft. during the week ended June 14, according to the National Lumber Manufacturers' Association. New business also increased during the week, while shipments fell off slightly on orders previously placed.

Demand and production are also on the increase in brick, lime, glass and the concreting materials.

Steel, therefore, occupies a position in direct contrast with that of the other basic materials. The U. S. Department of Commerce reports a drop in May bookings of steel castings and also in sales of fabricated steel structurals. These reports, combined with that of a drop of 580,358 tons in unfilled orders on books of the U. S. Steel Corporation and downward revisions in steel warehouse prices, may indicate danger of a similar trend in the other materials, especially since steel is regarded as a barometer of general conditions.

Reinforcing bars are now $2.20@$2.25; structural shapes, $2.10@$2.25 and plates, $2@$2.20 per 100 lb., at Pittsburgh mills.